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# Science



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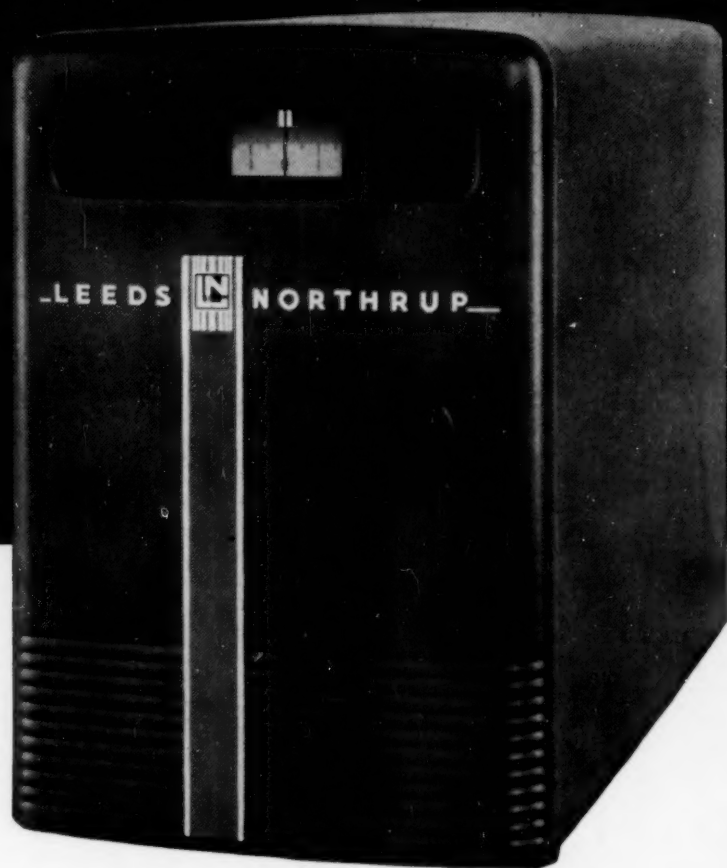
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After this date, applicants will be notified concerning the allocation of the labeled estrone sulfate, so that those to whom material can be made available may proceed promptly to secure the necessary approval from the Isotopes Division of the Atomic Energy Commission. Applications should be in the hands of the Commission by October 1, 1948.

It is expected that the radioactive material will be distributed in January, 1949. The investigators whose projects have been approved by the Atomic Energy Commission will be notified of the amount allocated and of the exact date on which they may expect receipt of the material. This, of course, is important since radioactive sulfur has a "half-life" of 87 days and should be used as soon as possible after it is received.

Investigators who are interested in participating in this program should send the information requested above to V. Johnson, Medical Department, AYERST, McKENNA & HARRISON Ltd., 22 East 40th Street, New York 16, New York.



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# Goals and Trends of Research in Geology and Geography

John L. Rich

University of Cincinnati

IN A TIME SUCH AS THE PRESENT, when conditions are unsettled, when the tremendous impact of recent scientific discoveries has turned attention as never before to science and to scientific research, and when all aspects of science are beginning to be of interest to the politicians, it seems pertinent to take stock of our situation as scientists and to inquire: What are the goals toward which we are working? What are some of the present trends in scientific activity? How may the attainment of our goals most effectively be promoted?

Before discussing goals, let us consider briefly the motives which inspire an individual to scientific endeavors. These may be personal gain or livelihood, desire for acclaim from his fellows, desire to contribute to the welfare of humanity, or just plain curiosity—an intellectual urge to understand. Most people probably work under a mixture of all of these motives, but for many of the world's greatest scientists we would probably find, if we could know the truth, that the last-named motive was dominant.

Industry presumably engages in research for the sake of gain or to improve its competitive position. Governments have long engaged in research as a service in developing and conserving the natural resources of the state or nation, and the public health.

Recently a powerful incentive leading to research by national governments has been *fear*—or should we, perhaps, say national security?—fear that some potentially hostile government may be first in the development of deadly weapons of destruction.

The fear motive leads to an aspect of research that may have most serious consequences both to scientists and to science in general—secret research. This is neither the time nor the place to discuss secret research further than to voice a plea that if research must be done in secret, let it be done exclusively by governmental agencies and by scientists who well know the implications of secret research; but, by all means, let it be kept out of the universities. Only the gravest national dangers of a war emergency would seem to justify introducing into the universities the state of mind implied by such research. This applies as well to commercially-sponsored research done in universities, except in instances when not even the briefest

period of secrecy and exclusive possession of the results of the researches is stipulated.

## GOALS OF RESEARCH

Whatever may be the motive which impels an individual to engage in scientific research, or a business organization or a government to support it, the primary goal to be attained would seem to be a better understanding of nature and of man and of how to apply that knowledge for the benefit of mankind.

Fundamental research—pure science—aimed at the acquisition of knowledge and understanding, must necessarily precede the application of that knowledge to “practical” ends—applied science, but both are necessary if the final goal is to be reached. It seems to me that practical application is the ultimate long-range goal of all research, but, as already pointed out, it is not, and it should not be, either the goal or the impelling motive of all researchers. Besides, an ultimate practical goal is not necessarily soonest reached by a direct approach. The shortest route may lie through researches having no immediately or even remotely visible practical applications.

Let us turn now to a consideration of goals in our own sciences.

## *The Goal in Geology*

In Geology we already have amassed a large body of information and have effectively solved many of the problems which puzzled earlier workers. But many of the most fundamental geological problems still remain unsolved and, for some large categories of fact and distribution, we have scarcely made a beginning in the collection and assemblage of data. One example is the problem of the interpretation of ancient sediments in terms of the environment of deposition. This problem is at present held up by lack of detailed knowledge of the kinds and distribution of materials being deposited on the sea bottom of today.

Many of our unsolved problems are related either directly or indirectly to another major problem—the mobility of the outer shell of the earth. We may mention, specifically, the origin of compressional mountains of the Alpine type, isostasy, continental drift, regional metamorphism, the origin of geosynclines, and many others. Among immediately practical economic problems, we have not yet solved that of the

Adapted from the address of the retiring vice-president of the Section on Geology and Geography (E), AAAS, delivered on December 26, 1947, in Chicago, Illinois.

origin of oil, nor are we entirely clear as to the mode of formation of certain types of ore deposits.

For the solution of many of these problems the mere collection of facts is not enough. Facts are infinitely numerous, and any attempt to obtain "all the data" on a problem is likely to result in such an unwieldy mass of mostly irrelevant information that the solution may be hindered rather than furthered.

To be efficient, the gathering of data must be selective, and the best guide to its collection is probably the method of multiple working hypotheses proposed many years ago by Chamberlin (1). The available information is first studied and analyzed; several working hypotheses are formulated; from each of these are deduced the consequences which should follow if that hypothesis were correct; further data are then sought and the old data re-examined for evidence which would either bear out or refute the hypothesis under scrutiny.

When search for data is thus guided, there will be a minimum of blind collection of irrelevant facts and a minimum cluttering of the literature with undigested factual information.

The formulation of correct hypotheses may have to await the coming of the right man endowed with some measure of genius. It is doubtful if it can be hurried by any amount of research planning or expenditure. It may even have to await the development of new ideas in other lines of science, such, for example, as the discovery of radioactivity and its heating effect, which may prove to be the key which will unlock some otherwise insoluble mysteries.

In order to progress most surely and most rapidly to his goal—the solution of his geological problems—the geologist should, it seems to me, avoid premature wanderings into other related fields. He should give first and most serious attention to the *geological* evidence, giving most weight to that which is simplest and most obvious. He should frame his *working* hypotheses to harmonize with that evidence, and he should enter the domain of the other sciences only as he follows out trails suggested by these working hypotheses. His excursions into other fields will then be directed and purposeful and, in all probability, fruitful.

The above procedure demands careful analysis of existing data and constructive imagination in formulating hypotheses and in deducing their consequences. No amount of footwork can substitute for headwork in analyzing the data and in formulating and testing working hypotheses. This calls for a different order of geological talent than that needed for mapping and the collection of factual information. The footwork can be hired and can be done by any reasonably well-trained geologist. The headwork may *possibly* be

hired, but it cannot be commanded or produced at will by executive decree; and it is not likely to be developed in committees.

### *The Goal in Geography*

For many years the geographers of the United States have seemed to be at a loss as to just what Geography is. Many years ago, a survey of geographical literature revealed a surprising number of papers bearing titles such as "The Scope of Geography"; "What Is Geography?"; and "The Circumference of Geography." A goodly number of such titles still appear. In a subject such as Geography, covering a wide range of interests and in which no general agreement has been reached as to proper content, it is natural that the goal should be ill defined.

Geography, as now understood, includes purely physical aspects—Geomorphology, Physiography, Meteorology, and Climatology—as well as Regional, Commercial, or Industrial, Human, and Political Geography.

Can we find some tie which binds together all of these widely diverse subjects and name a goal toward which all of them should consciously or subconsciously be aimed? If such a goal could be defined and generally accepted, it might give a direction and purpose to geographical studies which they seem not to have had in the past.

Tentatively, we propose such a goal: "The ultimate goal of Geography is an understanding of the natural and the human environments to the end that the natural environment may best be utilized for the benefit of humanity."

Such a goal emphasizes our view that, for scientific studies of all kinds, the final goal is reached only when their results are applied for the highest good of humanity. As "pure science," the basic scientific studies are vital, and in satisfying intellectual curiosity they may have a high function and provide a powerful motive, but neither the gathering of data nor understanding nor the satisfaction of intellectual curiosity seem to me to constitute final goals.

With a goal such as that proposed above, the various branches of Geography fit into place. The physical branches define the environment; the more "human" branches deal with past and present human reactions to and upon the environment; but the attainment of the final goal of the science demands that, after a particular environment has been defined, we learn how, in the light of the latest developments in other sciences, we may make the best possible adaptation to it. This is not, in any sense, to urge that all geographical studies should, by themselves, have a practical slant. It is, rather, to define the long-range goal of the science.



By way of illustration, let us imagine a study of the methods used by the Algerian natives to conserve their scanty water supply and to make it contribute to the growth of the best possible crop of dates. Such a study, by itself, would be interesting and even fascinating. It might be followed by other studies of how men in other lands or in other ages have solved the problems posed by a similar climate. But to approach as closely as possible to the goal which we have here set up, it would need to go further or to be supplemented by other studies pointing out how, not only considering various devices which men have invented and used in the past, but also in the light of the latest developments in modern science and in social organization, men might best utilize such a topographic and climatic environment as that of the parts of Algeria under consideration.

The attainment of our goal will be difficult and definitely is not a job for a novice, but the goal would give point and direction to the studies of even a beginner working on some specific and limited phase of geographic endeavor.

#### TRENDS

Having considered briefly the goals of geological and geographical research, it is in order to examine some of the trends which have been developing in recent years, in an attempt to determine whether they are likely to lead most directly and economically to the desired goals. These trends are of two sorts, one being related to the work itself and the other to its financing.

Among trends of the first sort, the following may be listed:

(1) Toward what may be called "research by committee," involving elaborate planning and organization and elaborate and all-inclusive fact-gathering.

(2) Toward crowding of scientific meetings and overburdening of scientific literature as a result of the prevailing practice of soliciting papers for scientific programs.

(3) Away from thought, critical analysis, and the formulation of working hypotheses.

(4) Toward continually lessening discussion, at meetings and in journals, of work already done and of hypotheses proposed.

During the past few years the idea that a baffling problem could be solved, if only a large and sufficiently active committee would go to work on it, seems to have pervaded the domain of scientific research. Without intending criticism of those who have worked so diligently on such committees, one is led to wonder if more might not have been accomplished if the committee members had spent an equal amount of time on their own researches.

The long and comprehensive outlines of proposed research projects typically turned out by a research committee are generally too vague to be of much aid to a graduate student and are not likely to appeal to the independent-minded scientist. To attack properly the problems as outlined by the committees would seemingly require a large, highly organized, and closely supervised research organization.

Research committees undoubtedly are useful when they point out gaps in existing knowledge which act as barriers to further advance. A committee may do better than an individual in judging what researches are *strategic* (2) in this sense, and its recommendation may carry more weight than that of an individual when backers are being sought to help finance the attack on these strategic barriers. But a research committee cannot be expected to supply that flash of understanding which, by recognizing the connecting links between various lines of evidence, not uncommonly leads to the final solution of a problem.

Not a few project outlines give the impression, by that very completeness already mentioned, that they are aimed at gathering "all of the data" in a rather broad field. As already explained, such would be a futile and wasteful attempt, because both data and interrelationships are infinite in number.

Entirely aside from what might result from projects formulated by research committees, the amount of uncorrelated, undigested, and unanalyzed factual material that is accumulating is enormous, and it continues to pile up at an ever-accelerating rate. A rough survey of publications of the *Bulletin of the Geological Society of America* and of the *Bulletin of the American Association of Petroleum Geologists* over the last two years revealed that 75% were factual papers with little or no analysis, 19% were analytical, theoretical, or methodological papers, and 6% contained mixtures of both.

Such an enormous and rapidly-growing accumulation of undigested published factual material poses a serious problem in indexing and abstracting which will soon require serious attention.

The trend toward the burdensome accumulation of data is undoubtedly furthered by the current practice of soliciting papers for the meetings of scientific societies, instead of depending on voluntary contributions. Would not the meetings be better and more stimulating if fewer papers were given, and those few by men who had something to say that they were definitely anxious to put before their fellows?

This leads directly to a consideration of the final trend listed above. Papers which seem to many to contain fallacies and nonsequiturs are given at the meetings and then, not infrequently, go through to publication without discussion. Perhaps, in the long

run, the fallacies will be revealed, and probably it is true that well-informed workers in the field recognize them and quietly ignore them. But such a procedure is to be regretted, because the student and the less fully-informed worker in that or related fields is generally not in a position to recognize the fallacies and therefore gains false impressions which retard progress. Active criticism and discussion are stimulating and salutary and should help toward keeping the published literature less voluminous and more trustworthy. What if bitter personalities are injected occasionally into verbal discussions? These are quickly forgotten if editors keep them from appearing in print. Lack of discussion and criticism in meetings is partly due to the difficulty of effective discussion in the largely attended meetings now prevailing. Means of minimizing the difficulties might well occupy the serious attention of those in charge of meetings. Eliminating the solicitation of papers would help.

#### *The Financing of Research*

Methods of financing research have an important effect not only on the research itself but also on the freedom of the individual or the institution engaging in it. Momentous changes in the ways by which money is provided for research are due to the drying up of endowment incomes provided by individuals, by which research formerly was supported in the universities and private research organizations; to increased expenditures by governmental agencies; and to greatly expanded research programs sponsored by industry or by commercial associations such as the American Petroleum Institute.

Research of the type that has long been carried on by many Federal agencies, such as the Geological Survey, and by various States, seems to be an entirely appropriate function of government—especially when it is directed to projects of a broad, fundamental nature, not appropriately done by industrial organizations having limited objectives, or to projects for which necessary equipment is too expensive to be provided by institutions such as universities. No objection is likely to be raised to the expansion of such research to whatever extent may be sanctioned by Congress, provided the research is done in government laboratories by government personnel.

Likewise, the expansion of industrial research to any desired extent seems salutary. But on the other hand, a recent trend in the financing of university research seems fraught with peril.

Research in universities has been badly crippled because decrease in endowments came at a time when rising costs and greatly increased enrollments, coinciding with a decrease in the number of available instructors, resulted in burdensome teaching loads and in greatly decreased faculty time available for research. It is, therefore, perhaps only natural that a strong tendency has developed toward seeking governmental aid in the financing of university research. But governmental aid, particularly Federal aid, for universities is not without serious drawbacks and dangers. The elaboration of that aspect of the subject would be out of place here and will be attempted elsewhere. Suffice it to say that the trend toward the seeking of Federal support for research in universities is strong and that its desirability should be most carefully analyzed, for this trend carries with it the possible danger of governmental control and the lessening of freedom in the universities.

#### SUMMARY

Summarizing in a few words the essence of the preceding analysis of goals and trends in research in Geology and Geography, we may say that the goal in Geology is a knowledge and understanding of the earth and of its history. In Geography it is a knowledge and understanding of the natural and human environments, to the end that they may best be utilized toward better living in the broadest sense.

Trends in research in these sciences that seem not altogether desirable are those toward overorganization of research and overdirection from others than the ones who are to do the work; toward indiscriminate fact-gathering; toward lessening of critical analysis of, and discussion of, papers given at meetings and of the published results; and toward premature publication and excessive volume of publications resulting from the prevailing practice of soliciting papers for scientific meetings.

Changes in methods of financing of research resulting from a great decrease in endowment incomes are noted, together with a strong tendency to look toward the Federal Government for the financing of university research, in spite of the obvious dangers to university freedom which such financing involves.

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1. CHAMBERLIN, T. C. *J. Geol.*, 1897, 5, 837-848.
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# The American Philosophical Society:

## *Abstracts of Papers Presented at 1948 Meeting*

### **The Prehistoric Archaeology of the Tangier Zone, Morocco**

Hugh Hencken

American School of Prehistoric Research

Tangier is archaeologically important because there Europe and Africa meet, and for thousands of years people have been moving between the continents.

The Tangier Expedition (1947) of the American School of Prehistoric Research, financed in part by a generous grant from the American Philosophical Society, completed previous work of the Peabody Museum of Harvard University. The following represents work done in 1947 unless otherwise designated. The sites included both Old Stone Age cultures of the Ice Age, when man hunted his food rather than producing it, and the New Stone Age culture, which depended on the keeping of domestic animals.

The oldest site was on Cape Ashakar, south of Tangier. Here there were gravels left by streams that had flowed into the Atlantic when it was 60 feet higher than today—in other words, in the earlier part of the last warm interval in the Ice Age, possibly 150,000 years ago—and here were found a heavy flint cleaver and hand axes of Acheulean type. Another site, near the Mackay Radio Station, contained a deposit connected with the sea when it was about 40 feet higher than today, possibly 100,000 years ago. This represents a later stage (Levallois-Mousterian) in the making of flint tools. Both sites represent ancient cultures traveling across Africa from the Middle East to Europe.

The third site, the High Cave on Cape Ashakar, had been largely excavated before the war, but work was continued in 1947. This was occupied during the later Ice Age by "Aterian" hunters who used skillfully made flint darts to hunt elephants, giraffes, rhinoceroses, and hippopotamuses. These central African creatures lived in North Africa at that time, because, owing to the glaciation in Europe, North Africa was a lush, well-watered place where the animals would find food. These conditions probably ended about 10,000 years ago, leaving North Africa dry as it is today.

Among the Aterians were at least some persons of the extinct Neanderthal race of man, for a few teeth and part of an upper jaw were found that belonged to them. These Neanderthals had probably come over from Europe.

Later, this cave, and two others dug in 1947, were occupied by New Stone Age people from the borders of Egypt, where they had learned to make pottery and to keep cattle, sheep, and goats. These same people also overflowed into Europe. They arrived 5,000 or 6,000 years ago, and they still continued their simple pastoral existence in the period of the Roman Empire (1st to 4th

Centuries, A.D.). Their descendants today are the Berbers, who are as impervious to European civilization as their ancestors were in Roman times.

### **Political Distortions in International Monetary Relations**

Jeannette P. Nichols

Historian

For centuries, monetary functioning has been generally regarded as a sovereign right of the state, with policies based primarily upon domestic considerations and with slight regard for international repercussions. This practice largely persists, but is it tenable?

With the rise of modern representative government, domestic political pressures for currency manipulation were sharpened. In hard times clamorous demands for hurried currency panaceas assail the ears of legislators and administrators, who for their part lack the understanding or the political strength to direct policy wisely and yet stay in office.

Simultaneously, development of highly industrialized economies has vastly increased the economic interdependence of nations; the growth of trade has given an international factor—exchange rates—a mighty influence upon national prosperity and international relations. This influence is especially felt in times of violent, rapid change, such as the period since 1914. Yet monetary manipulation continues to be governed mostly by national considerations and has become a powerful aid to military objectives.

Agonies of World War II impelled the first broad, serious effort to relinquish some monetary sovereignty in the interests of mutual peace and prosperity. From Bretton Woods emerged the International Bank and the Fund. But almost at once political conflicts (domestic and international) were allowed to dull these instruments for peace, preventing their functioning as planned. Their ineffectiveness moved the United States to forge, alone, new monetary weapons for waging peace—the "loans" and the "Marshall Plan." Whether these are sharp or clumsy instruments remains unproved.

The perilous situation challenges economists and politicians to pool their talents in the public behalf. This means, among other things, surmounting the obstacles to their mutual understanding and respect, so they can work together. Their cooperation is essential to prosperity and peace; for exchange rates and other monetary forces are affected by so many political and economic influences, in so many national and international aspects, that monetary interactions are extremely hard to unravel and even harder to control. Every nation desperately needs such practical alliances between people of thought and action, to plan and implement domestic monetary policies which

shall take fair account of international monetary dependence. Without such joint efforts, the world may not find the needed monetary compromise between national sovereignty and international welfare.

### The Chinese Language in the Light of Comparative Semantics (A New Approach in Historical Linguistics)

Erwin Reifler  
Washington University

In the course of researches carried on over a number of years, the fact has emerged that the Chinese language, because of its peculiar writing system, is a treasure mine for semantic research to a degree which has not been suspected previously. In this respect it surpasses all other sources of linguistic semantic material. However, while all other branches of Chinese historical linguistics—especially the study of phonology and epigraphy—have made great strides in the past, Chinese semasiology has lagged far behind. This appears to be due to the failure to either realize or consistently apply certain principles in our study of the growth of the Chinese language and its writing.

However, once these principles were realized and consistently applied, a very large number of semantic problems found their obvious solution without recourse to any source of relevant knowledge outside the Chinese language.

Nevertheless, there still remained a fairly large number of cases which, in spite of all phonological, graphological, and semasiological data supplied by the Chinese language and its writing, defied all attempts at an objective solution. And it is in many of these cases that the importance of Comparative Semantics has been realized.

Our treatise endeavors to substantiate this claim in two parts, the first dealing with the problems involved in the semantic analysis of the Chinese language, the second giving a demonstration of our solution of Chinese semantic problems.

One of the many examples adduced in this demonstration is supplied by the Chinese words for "to shoot" and "to dismiss," which show a remarkable phonological and graphic agreement. A common origin of these words was, nevertheless, hitherto not envisaged because of their seemingly incompatible meanings. However, the analogy of English "to fire" shows that such meanings can be homogeneous.

### Some Problems of Small Nationalities in Europe

Fred N. Robinson  
Harvard University

This paper will not be concerned with the smaller independent nations like Switzerland, the Scandinavian countries, and the Netherlands, or with the racial minorities in Central and Eastern Europe, whose treatment was a matter of such violent controversy just before the recent war. There are many similarities, to be sure, between the situations in these latter countries and those to be dis-

cussed. But the paper will deal primarily with certain groups that have long formed part of larger political units but have preserved, in greater or less measure, separate languages and cultural traditions. During the past century, when the major political and social forces seemed to make for the diffusion and dominance of a few leading civilizations, there were in various parts of Europe movements for the revival of declining or vanishing nationalities. Some of these *mouvements régionalistes*, to give them the French name by which they have been most commonly known, aimed at political independence, and others were mainly cultural in purpose. Nearly all their phases appear in the nationalistic struggles of the Celtic-speaking inhabitants of the British Isles and France. The Gaelic revival in Ireland is the one best known in America, and partly for that reason the similar revival in French Brittany will be chosen here to illustrate the general problem. After a brief survey of the history of the movement some account is given of the present state of Breton nationalism and of the questions at issue between the regionalist patriots and the central government of France.

### An Unfamiliar Mechanism of Disease Transmission

Richard E. Shope  
Rockefeller Institute for Medical Research

While it is well known that many diseases are transmitted by insect intermediate hosts, it is not so well known that a small group of infectious agents are carried by helminth (worm) intermediate hosts. The three helminth-transmitted diseases to be discussed are blackhead of turkeys, salmon poisoning of dogs, and influenza of swine.

The causative agent of blackhead is the protozoan, *Histomonas meleagridis*, and the intermediate host of this parasite is the common cecal worm, *Heterakis gallinae*.

The exact nature of the causative agent of salmon poisoning is not yet known, though a virus is suspected. Its transmitting host is the fluke, *Trogloitrema salmineola*.

Swine influenza is caused by the concerted activity of a bacterium and the swine influenza virus. The virus has as its intermediate host the common swine lung-worm.

It is believed that the three diseases now known to be transmitted by helminths represent only a portion of a larger group and that further investigation of diseases whose epidemiology is still not completely understood will enlarge the group.

### International Developments and the American Economy

Simon Kuznets  
University of Pennsylvania

The rest of the world exercises its effects on the domestic economy of the United States via either the peaceful channels of migration, foreign trade, and international capital movements or the warlike types of contact, of ag-



gression and defense. Prior to World War I, the economic development of this country was accompanied by free migration; by a restricted, but undiminished, rate of participation in world commodity trade; by a limited, but consistent, net debtorship position on international capital accounts; and by freedom from participation in major wars, despite a striking expansion of territory. After World War I, the character of economic relations of this country with the rest of the world changed drastically; migration was restricted in the 1920s, came to a virtual standstill in the 1930s, and was not resumed on any significant scale; the share of foreign trade to domestic output, after a brief expansion in the 1920s, suffered a reduction that has not been made up since; the country shifted to a net international creditorship position; and participation in both World Wars, if belated, could not be avoided. Most important, the expansion in the world of free enterprise and of political democracy that were characteristic of the 19th and early 20th centuries and that provided a favorable international climate for the development of the United States (and of other countries with similar social institutions) gave place, after World War I, to opposite trends. The problems created by the impact of current international relations on the domestic economy of this country result from a conjunction of three circumstances: (a) emergence of the United States to a status of economic leadership; (b) recession across the world of free enterprise and of political democracy, and the vigorous growth of opposite tendencies; (c) acceleration of technical changes in transportation and communication, which raise the technical potential in overcoming space and other obstacles and thus permit competing national units closer contact, of a peaceful or warlike character.

### The Impact of International Developments on the American Economy

Friedrich A. Lutz  
Princeton University

The most important economic issue of our time is that between the free market economy as it exists in the United States and the centrally planned economy which now exists all over Europe. The outcome of the struggle between these different systems hangs in the balance. Whether the ideology of central planning will triumph over the capitalistic ideology or whether the reverse will happen will depend largely on the actual performance of the two systems. If the American economy should again pass through a severe depression and mass unemployment, central planning, which seems to provide security of employment, will appear to the American public something worth imitating, and control of the economic processes is bound to make rapid progress, even in the United States.

The present international political tension has altered profoundly the character of American foreign trade and foreign lending. Foreign lending is now done by the Government and is dominated by political considerations.

"Dollar diplomacy" is the rule. Similarly, exports of commodities to potential enemies can be, and are, prevented today. In any event, American exports are now largely determined by the import controls imposed by foreign countries. Thus, the free market principle no longer applies to foreign trade or foreign lending.

Internally, the American foreign aid program will in the immediate future cause shortage of certain commodities and is likely to strengthen inflationary tendencies. In the longer run, the American economy will be profoundly affected by (1) the revival of foreign agriculture, which will require as its counterpart a contraction of American agriculture; (2) the industrialization of undeveloped countries, which will necessitate structural adjustments in American exports and imports; (3) the repayment of American loans, which will reverse this country's balance of trade. All three factors will strengthen the protectionist forces in this country, and the United States may cease to be the champion of the policy aimed at reducing trade barriers. In this case, the hope for freer international trade, which now rests primarily on the efforts of the United States, will vanish.

### The Impact of External Affairs on American Public Opinion

Carroll Binder  
Minneapolis Tribune

It took three wars and the imminent threat of a fourth war to make the American people realize the full implications of their status as a super power.

Victory over Spain signalized the emergence of the United States as a great power half a century ago. World War I transformed the United States from a debtor to a creditor nation and left Great Britain too weakened to vie with the United States in naval or financial power.

Only a minority of the American people comprehended the epochal significance for themselves and for the rest of the world of these changes in their status. During the first decade of great powerdom Theodore Roosevelt, John Hay, and a few other leaders exercised America's newly acquired influence in world affairs with far-reaching consequences, but the great body of American people were too unfamiliar with the forces at work in Europe and Asia to appreciate their bearing on their individual and collective well-being.

Most Americans pursued the even tenor of their way as though the United States was still in the 19th Century and there would always be a Britain strong enough to hold the sea lines against any European power's attempt to extend its sway to the western hemisphere, and prosperous enough to pay cash for the surplus products of America's expanding agriculture and industry.

Because World War I was oversold to them as a crusade to make the entire world safe for democracy and to end war for all time, the great majority of Americans were sadly disillusioned by the aftermath of that conflict.

Had the rank and file of Americans realized that they had to join in the war against Imperial Germany because

Germany otherwise would have won that war and they would have been the next victims of German aggression, without powerful allies to help them resist, they would have been better prepared to cooperate in the making and maintenance of a decent peace. Had they been better versed in the economic facts of life, they would have avoided the painful losses they sustained by rash overseas lending made without thought of how it might be repaid or how injuriously the loans might be employed.

It took the fall of France, the battle of Britain—and Pearl Harbor—to convince the American people as a whole that the United States was too challenging a citadel of freedom, prosperity, and potential power to be left undisturbed by any power bent on world conquest.

When the American people realized that it was up to them to determine whether they and their allies or the axis would survive, they astonished the world by their war effort and decided the issue of that battle for the world.

Once again, the outcome of a costly war effort is disappointingly short of what the American people expected to achieve. Having spent 400,000 American lives and \$354,000,000,000 to defeat one totalitarian menace to their freedom and security, they are deeply resentful that their peace and security are menaced by another totalitarian regime—a regime to which they gave enormous material assistance and to which they made costly strategic concessions in the hope of enlisting its permanent cooperation in the making of a decent and lasting peace.

World War II and its aftermath has taught the American people that they no longer can afford to remain indifferent to what goes on in Europe and Asia. It has taught them that their peace, freedom, and security depend on their strength and wisdom rather than on their geographical position and some other power's holding the lines against aggressively-minded totalitarianism.

The American people have learned the hard way that they are permanent members of the world community and that, as possessor of half the industrial capacity, financial resources, naval, military, and air strength of the postwar world, they must take the lead in mobilizing the freedom-loving nations of the world to resist Russian attempts to sovietize them by infiltration, by the creation of chaos, or by armed aggression.

American thinking has traveled far in power politics during the last 50 years under the impact of external events. We have much to learn. We still make costly mistakes because of our inexperience. But we no longer live in a fool's paradise.

## Repercussions of Foreign Affairs on the American Tradition of Civil Liberties

Robert E. Cushman  
Cornell University

The United States emerged from World War II a dominant world power inextricably involved in world affairs. This new international position has had two sharply differing repercussions upon the American tradition of civil liberties. First, we stand as the world's leading exponent

of a liberal democracy, in which the adequate safeguarding of civil liberties is implicit. We have assumed leadership in the movement for an International Declaration and Covenant on Human Rights. Trying to pose, however, as an example to the rest of the world has made us aware that we do not fully practice what we preach, that we are not, for example, extending justice and equality to our racial minorities. Our new international position is exerting a wholesome influence in the direction of leading us to live up more fully to the American tradition of civil liberty in order that that tradition may be more effectively spread throughout the civilized world.

On the other hand, the hostility of Soviet Russia, the unpredictability of atomic warfare, and the frightening disclosure of espionage in Canada, have created a form of hysteria and fear on the domestic scene which is seriously undermining the civil liberties protected by the First Amendment. We are actively engaging in loyalty tests, investigations of "subversive" and un-American activities, which in some cases tend to deteriorate into witch hunts. These affect civil liberties directly in the impact upon the persons immediately concerned, and indirectly by producing an erosion of popular loyalty to the traditional principles of freedom of speech, press, and assembly. The American public is being educated in bigotry and intolerance.

## Trends in the Traditional Relation Between Military and Civilian

Harold Sprout  
Princeton University

The history of civilian-military relations in the United States reveals many contradictions and inconsistencies. Traditional civilian attitudes include: distrust of military leadership, vague fear of military domination, avowed support for the principle of civilian supremacy over the military in policy-making and administration. In practice, however, the American people have accepted an amount of military participation in public affairs inconsistent with their avowed traditions.

The past record of Congressional relations with the Armed Services is a mixture of sincere patriotism, mutual distrust, military careerism, lobbying, propaganda, log-rolling, and pork-barrel politics. Conditions have improved in recent years, but not enough to insure adequate Congressional appraisal of military needs and programs and the elimination of local and partisan considerations in the enactment of military legislation.

In World War II, the military gained an ascendancy never previously attained in the United States. Best efforts to extend full military control over the national economy encountered stubborn and partially successful civilian resistance.

One phase of this struggle centered on manpower, with higher education caught disastrously in the squeeze between conflicting interests. The result today is an acute shortage of teachers and research personnel in both science and the liberal arts. Other states, including the Soviet Union, followed the opposite policy, carefully



maintaining a flow of talented youth through their universities, despite military and industrial demands for men. To the extent that national strength depends upon trained personnel, the American policy was shortsighted and places a mortgage on our future power and capacity for world leadership.

The war wrought significant changes in the relations of the military with civilian agencies responsible for foreign policy. Steps have been taken to bring military policy into better balance with political aims and commitments. In the process the military services have gained a larger share in policy-making. Under present conditions their influence on foreign policy will certainly not diminish; it will probably increase. In case of full-scale war, the military might well come to dominate every important function of American society, economy, and government.

In their present temper the American people have gone far toward embracing military viewpoints and solutions. This may be attributed in large degree to the crisis in Soviet-American relations. The trend of Soviet policy is disquieting from any point of view. The creeping advances of revolutionary communism, its insidious growth in our own society, and the mental image of American cities bombed to smoking rubble, can be morally devastating, especially to minds long habituated to the comforting thesis that "it can't happen here."

But there is real danger that Americans may place too much faith in the ability of military therapy to cure the disease of our time. Military power has an important role to play in bringing order out of the present chaos—role for which there is no adequate substitute. But American democracy cannot survive by military power alone. Any policy based too exclusively on preparation for an "inevitable" third world war exposes all nations, our own included, to frightful devastation, destruction of democratic society, and the possible suicide of our civilization. Only a wise combination of firmness with conciliation, which brings to bear all the tools of statecraft—political, economic, and moral, as well as military—will enable the United States to play a constructive world role.

## The Decline of Tuberculosis as the Chief Cause of Death

Esmond R. Long

Henry Phipps Institute, University of Pennsylvania

Tuberculosis has been the principal cause of death in the world until recent times and is still the chief cause in the Orient and other regions. Its history as an endemic disease can be traced in the western world from a combination of written records and knowledge of former living standards. It was widely prevalent in ancient times and reached its peak in Europe with the industrial revolution. It has declined throughout the western world with the rise in standards of living and application of specific measures for tuberculosis control. In the United States the tuberculosis mortality rate has dropped 80% in the last 50 years. Education of the public on the con-

tagious nature of the disease, establishment of tuberculosis control units in health departments, extensive hospitalization for the isolation and care of tuberculous patients, rapid methods of case-finding, and effective methods of treatment of the disease have all been important factors in the decline. The war seriously interrupted tuberculosis control in Europe, but recovery has begun. With the normal operation of public health programs the mortality should decrease steadily, but the future cannot be predicted as long as political, economic, and social conditions remain unstable.

## Franklin's Return From France, 1785

Charles F. Jenkins

Historical Society of Pennsylvania

Franklin sailed for France in September of 1776 and did not return until September of 1785. For 8½ years his home was in the suburban village of Passy, two miles out of Paris. Shortly after the surrender of Cornwallis, Franklin urged Congress to allow him to return. He was tired, ill, and homesick. In May of 1785 he received his discharge and immediately preparations were under way for the return voyage. Because of his malady he could not walk, ride horseback, or even ride in a carriage. Various plans were considered, including the fantastic one of riding in the basket of a balloon fastened to a cart to direct its progress. The problem was solved by the offer of the royal litter. This was a curtained couch, suspended between two large mules, front and back, with the muleteer riding the lead. The 127 pieces of baggage were sent down the meandering Seine by barge. It was 146 miles by road to Le Havre, and 5 days were required to make the journey.

At Le Havre a ship had been taken for Southampton, England, where the "London Packet" had been chartered to bring them to Philadelphia. Here Franklin bade a last farewell to his son, Governor William Franklin, and negotiated the purchase of the latter's lands in America to be conveyed to William Temple Franklin. The "London Packet" was a new Philadelphia-built ship of 300 tons, commanded by Captain Thomas Truxtun, who later achieved renown as a Commodore in the American Navy. Also on board was the celebrated sculptor, Houdon, who was coming over to make a statue of Washington for the state of Virginia.

The voyage lasted 48 days. Franklin had agreed with his friends that he would use the time in writing his autobiography, but instead he wrote three scientific and philosophical articles which were later read at meetings of the American Philosophical Society, of which he was founder and president. The arrival of the "London Packet" in Philadelphia on September 14 was acclaimed by salutes from cannon, the ringing of church bells, and the ships in the river with their flags flying. A great crowd assembled at the Market Street wharf to welcome him and follow him to his home in Franklin Place.

Franklin's health had improved on the way home, and, although his malady continued with him to his death, he lived for 5 years to become president of Pennsylvania for

three successive years and a delegate to the Constitutional Convention in 1787.

A Committee of Congress is considering the possibility of restoring his home and garden in Franklin Place, now Orianna Street, between Market and Chestnut Streets.

## Public Spirit and American Improvements

Carter Goodrich  
Columbia University

In 1769 the Committee for American Improvements of the American Philosophical Society investigated the possibility of a canal from the Chesapeake to the Delaware, aided by a subscription by the merchants of Philadelphia, who responded to an appeal to their known public spirit.

Similar attitudes persisted throughout the movement for internal improvements between the Revolution and the Civil War. The extent of government activity and the curious combinations of public and private investment in "mixed enterprise" corporations cannot be understood without realizing that the road and canal and early railroad enterprises, whether public or private or mixed in ownership, long continued to be thought of as "public-spirited undertakings."

This public spirit was often the self-interest of a locality, a section, or a state. The rivalry of the seaboard cities for the western trade played a large part. The Pennsylvania Railroad began as a mixed enterprise representing part of the competitive effort of Philadelphia. But broader motives of national interest and unity were of continuing importance.

Gradually "public duty" and "private interest" became more sharply separated, partly because of opposition to the use of public money to aid private profit-seekers and partly because of opposition to public participation in fields which private enterprise could occupy with profit. The intermingling had been largely the result of the inability of private business to raise enough capital for the larger undertakings. Yet even today it is worth recalling the part played in the development of transportation by community planning and the conscious pursuit of public ends.

## The Light From Distant Galaxies

Joel Stebbins and A. E. Whitford  
Washburn Observatory, University of Wisconsin

With a photoelectric photometer on the large telescope at Mount Wilson, measures have been made of the total light and color of external galaxies down to the 18th magnitude, near the limit of what can be seen visually through the 100-inch telescope. The quality of the light is what would be expected from mixtures of many stars both hotter and cooler than the sun. Also, the distant galaxies are distinctly redder than near-by ones. The reddening is proportional to the shift of the spectrum lines and has been followed from the nearest examples, comparative neighbors of the sun less than 1,000,000 light-years away, to a member of a cluster in the constellation Boötes at a distance of 200,000,000 light-years.

Hubble and Humason's measure of red-shift of the spectrum lines of this galaxy indicate an apparent outward velocity of 24,000 miles per second, or 13% of the velocity of light.

About half the measured reddening can be explained by the effect of the red-shift, but the remainder is unaccounted for. The unexplained reddening could be a distance-effect caused by selective absorption in space between the galaxies, such as is produced by dust between the stars in our own galaxy. Or the reddening could be a time-effect, if the galaxies which we see as of 200,000,000 years ago were actually redder than those we see close at hand now. But, whatever the cause, the reddening has the effect of making the nebulae appear fainter to the photographic plate, and many nebulae which could otherwise be reached photographically are thereby lost. Therefore, the counts of faint nebulae and the inferences from them concerning the remote depths of the observable universe must be re-examined.

## Variable Stars—A Study Completed

Cecelia Payne-Gaposchkin and Sergei Gaposchkin  
Harvard University

The study of the 1,500 brightest variable stars, begun 9 years ago, has been completed. Light variations, periods, ranges, and other properties have been obtained for 400 long-period and 400 semiregular variables, 150 Cepheids, and 50 cluster-type stars. The data permit a study of physical properties of these stars, both as individuals and as representatives of the stellar populations to which they belong.

The Cepheids partake of the rotation of the Galaxy and are the characteristic intrinsic variables of our neighborhood. By reference to the well-determined properties of the Cepheids in the somewhat similar environment of the Magellanic Clouds, it is possible to study the absolute properties of these stars and the deviations of individuals from the normal.

The cluster-type variables are interlopers in our neighborhood and represent the population characteristic of the galactic center. By comparison with those in globular clusters, the properties and anomalies of the cluster-type variables in our vicinity can be studied.

The long-period variables comprise two overlapping groups, both intermediate in properties and affiliations between the Cepheids (Population I) and the cluster-type stars (Population II).

The semiregular variables (for many of which the character of the variation is now established for the first time) also represent two intermediate groups, but the Population I group predominates; semiregular variables of Population II are of distinctive behavior.

An important part of the investigation has been the redetermination of the apparent brightness of the groups of stars before mentioned, previously ill determined and inhomogeneous. It is thus possible to revise previous findings as to their absolute brightness. The enormously interesting question concerning the physical differences between the stars that inhabit the inner and outer por-



tions of our galactic system can now be approached on a quantitative basis.

About 400 eclipsing stars are included in the study. Discussion of them, which will be lengthy, will eventually contribute greatly to our knowledge of the physical properties of stars and will give especially full and important information on the frequent and unexplained changes of revolution periods for these double stars.

### An Attempt at Perspective (R. A. F. Penrose, Jr., Memorial Lecture)

Robert B. Warren

Institute for Advanced Study, Princeton, New Jersey

Some of the difficulties of appraising the problems of our time lie in the impossibility of seeing our own time in its historical perspective. We shall try, nevertheless, in the hope of throwing some light on the present.

Lord Acton once said that the 15th Century, which saw the discovery of the New World and the recovery of the Ancient World, marked the transition from the Middle Ages to the Modern Times. These discoveries set in motion forces which shaped the following four centuries. Among these consequences were the enlargement of the area of Christianity and the gradual ascendancy of Europe to world hegemony. The gold and silver of America changed the characteristic form of wealth from land to pecuniary capital. The Renaissance reoriented intellectual activity; in antiquity, it had been centered on philosophy; in the Middle Ages, on theology; after the Renaissance, on the material sciences. The supremacy of what Gibbon called the "Republic of Europe" was not primarily military, but cultural. Its cultural patterns were not imposed on the world; the world copied and emulated these patterns. This culture was predominantly materialistic. The previous age has been charged with superstitious religion; possibly the character of the recent age is superstitious materialism.

The conspicuous consequence of the discoveries was America itself. What difference has America made?

One of the great contributions was the undermining of the concept of hereditary status as the basis of social structure. It seemed at one time that the elimination of status would lead to the brotherhood of man.

If an historical period has a beginning, it must by definition have an end. There are reasons to imagine that the historic epoch initiated by the Great Discoveries has closed. The world supremacy of Western Europe has been ended by two internecine wars and by the revolt of Asia. The area of Christendom has been reduced by half, with the secession of Russia. Islam, after four centuries of lethargy, is once again a living factor.

The nation-state as the typical political form is not characteristic of the present. It appears to be in process of supersession by cultural federations whose political forms have not yet crystallized. The present political configuration of Western Europe appears like an anachronism in the contemporary world, but it is not impossible that Gibbon's "Republic of Europe" may become a political reality.

Another sequel to the Discoveries was the increase in world population. Up to recent years, an increasing population found fresh sources of food supply in new and empty lands. There are no such lands now, but population continues to increase; the traditional expedient is no longer available.

The elimination of a social structure based on traditional status and the intense preoccupation with material welfare have not produced the brotherhood of man but have given us, rather, two characteristic features of contemporary society—the class struggle and the magnified state. The state is no longer merely one of the agencies of society; it has become the dominant or even exclusive agency of society.

These examples suggest that the world which followed the Great Discoveries has already receded into history. We are moving toward a new world, but this new world has not yet lifted above its horizon.

Time as well as space has its voyages of discovery. On one of these we are now embarked.



# NEWS and Notes

**Arthur F. Hagner**, associate professor of geology, University of Wyoming, and assistant state geologist of Wyoming, will join the staff of the University of Illinois in September as associate professor of geology, filling the position in economic geology left vacant by the death of T. T. Quirke. Prof. Hagner has been on leave from Wyoming for the past year as research associate at the University of Chicago.

**Leonard Karel**, formerly acting chief, Toxicology Section, Army Chemical Center, Maryland, was recently appointed executive assistant to the Antibiotics and Pharmacology Study Sections, working in cooperation with the Division of Research Grants and Fellowships of the National Institute of Health. Dr. Karel is also on the staff of the University of Maryland School of Medicine as lecturer in pharmacology.

**Kenneth N. Campbell**, assistant professor of surgery, University of Michigan, has been appointed associate surgeon at the Alexander Blain Hospital, Detroit. Dr. Campbell has been conducting research on tetraethyl ammonium chloride in vascular disease.

**Richard B. Bernstein**, who will receive his Ph.D. from Columbia University this month, and **Eugene Lieber**, a senior research chemist at Armour and Company, have been appointed assistant professors of chemistry at Illinois Institute of Technology, effective September 1.

**Malcolm F. Smiley**, of Northwestern University, has been appointed professor of mathematics at the State University of Iowa. From 1938 to 1942 Dr. Smiley was on the faculty of Lehigh University, and from 1942 to 1946 he served as a lieutenant in the U. S. Navy at Annapolis.

**James H. Birnie** has been appointed assistant professor of zoology at Syracuse University. He has been

working for the past year as a research associate at Syracuse while on leave of absence from his former post as head of the Department of Biology at the Agricultural and Mechanical College, Orangeburg, South Carolina.

**Howard M. Phillips**, professor of biology at Emory University, has been named chairman of the Department of Biology at that institution.

## Grants and Awards

**Carleton A. Chapman**, of the Department of Geology, University of Illinois, has received a research grant from the University's Research Fund for continuation and extension of his field studies in the Claremont and Sunapee quadrangles of western New Hampshire. The stratigraphy, structure, and metamorphism of the Paleozoic sedimentary and volcanic rocks, and the granite tectonics involved in the formation of certain large intensives of probable late Devonian age, will be studied. Assisting Prof. Chapman in the field will be James H. Fisher, Haydn H. Murray, and Robert R. Shaver, graduate students in the department.

**The University of Utah Medical School** has received the sum of \$416,404 from the National Cancer Institute for the construction of a cancer research institute.

**The Woman's Medical College**, Philadelphia, has recently announced the receipt of two grants. The U. S. Public Health Service, National Cancer Institute, has provided \$24,958 in support of a cancer teaching project under the direction of Isabella H. Perry, who will be on leave for one year from the University of California Medical School, where she is assistant professor of pathology. Lloyd D. Seager, professor of pharmacology and toxicology, has received \$1,000 from the Abbott Laboratories for the continuation of a study of synergisms of chemotherapeutic agents in sleeping sickness. The College has also received a valuable gift of micro camera equipment from the Alpha Penn Link #23 (Order of the Golden Chain) for use in its cancer research work.

**The Royal Society of Edinburgh** has awarded the Neill Prize for 1945-47 to Robert Broom, famous South African paleontologist, for his contribution to scientific knowledge by his study of the fossil vertebrates of the Karoo Beds. Dr. Broom, known for his discoveries of "missing link" fossils at Sterkfontein, is the author of over 350 papers dealing chiefly with comparative anatomy and paleontology.

**The president of the Chicago Technical Societies Council**, Gustav Egloff, has just announced that the Council has named Wilfred Sykes, president of Inland Steel Company, to receive the 1948 Award of Merit. The Council's award is presented annually to the citizen in the environs of Chicago who has contributed most importantly toward "cultivation of greater appreciation by the public of the part which technology, engineering, and science have played in human welfare." Dr. Sykes, an electrical engineer and a native of New Zealand, has played an active part in professional societies, educational institutions, and manufacturers' groups.

**Saul Winstein**, professor of chemistry, University of California, Los Angeles, is the recipient of the 1948 \$1,000 prize of the American Chemical Society. The award is made annually to a North American chemist under 35 years of age who has made an outstanding contribution to chemical research. The award was based on a series of investigations by Dr. Winstein concerning the mechanisms by which atoms move in and out of molecules during chemical processes whereby new substances are being created.

## Colleges and Universities

**Plans are being made at Harvard Medical School** for a two-week period of demonstrations, laboratory exercises, and discussions designed to cover techniques and interpretations of recent work in the field of the pleuropneumonia-like organisms and the so-called "L forms" of bacteria. Emphasis will be placed on the possible pathogenic aspects of these organisms in human disease, the purpose being to stimulate interest in, and further work



with, this little-known aspect of bacteriology and to encourage critical comment on its implications.

The session will be conducted by Louis Dienes, bacteriologist at the Massachusetts General Hospital, Boston, and a member of the Department of Bacteriology and Immunology, Harvard Medical School. The exercises will be held in the D Building of the School, beginning June 14. Total number of participants will be limited to 20, and no fee will be charged. It is hoped that department heads will attend in person or designate representatives. Those interested are requested to communicate with Dr. J. Howard Mueller, Professor of Bacteriology, Harvard Medical School, Boston, Massachusetts.

Carnegie Institute of Technology recently announced that its proposed synchro-cyclotron will be increased in size to provide for an energy output of over 400,000,000 electron volts—an energy which will assure the production of mesons. Additional support for the project has been received from the Office of Naval Research and the AEC. Although the atom-smasher will be some 38% larger in volume, Edward C. Kreutz, administrator of the cyclotron project, states that an increase in size of the building now being constructed to house the machine will not be necessary. Change in construction plans for the cyclotron, which is expected to be in operation in 1950, were occasioned by the fact that recent experiments at the University of California indicate that mesons cannot be produced by bombarding protons with protons at energies much below the 350,000,000-volt level.

Plans for an ever-growing memorial to students, alumni, and staff who died during the war are being formulated at the University of Michigan by a special committee of which Dean Erich A. Walter is chairman. The idea for the memorial, to be known as the Phoenix Project, was originated by M. Fred Smith, of New York, a former student at the University, who pointed out the appropriateness of "administration and coordination of research in some specific phase of peacetime atomic research and construction of a building to house the program." Plans call for special

laboratories and workrooms. Although emphasis would be placed on science and medicine, it is intended that the social sciences and the humanities would also be integrated into the program. In addition, consideration is being given to an organized information exchange service which would be available for specialists working independently in the various fields. University President Ruthven, in announcing the project, stated that plans for securing funds to finance such a memorial would be completed this summer.

## Meetings and Elections

The Symposium on Electron and Light Microscopy, sponsored by Armour Research Foundation and Illinois Tech's Physics Department, will be held June 10-12 in the Stevens Hotel, Chicago, instead of on the campus of Technology Center, as previously announced. A number of leading microscopists in both fields will present papers in 5 sessions running through Friday, June 11. These technical sessions will include discussions of such subjects as dark-field electron microscopy, surface studies, phase microscopy, fiber studies, structure of fibers, resinography, micro-radiography, the application of microscopy to polymorphism of tristearin type fats, particle sizes and shapes, studies of photographic gelatin, biological applications, and polarized light. Panel discussions will be held on Saturday on (1) Instrumentation for Electron Microscopy, (2) Instrumentation for Crystal Optics, (3) Applications of Microscopy to Biology, (4) Preparation of Metal Surfaces for Microscopic Examination, and (5) Problems in High-Speed Microtomy. Participants will be drawn from commercial and governmental laboratories and from educational institutions.

As a part of the University of Wisconsin Centennial Celebration, the Medical School, in cooperation with the Department of Zoology, College of Agriculture and Biochemistry Division, Wisconsin Alumni Research Foundation, the Committee on Growth, acting for the American Cancer Society, and the McArdle Memorial Laboratory for Cancer Research, is

sponsoring a Symposium on Steroid Hormones on September 6, 7, and 8. Certain expenses in connection with this symposium are being underwritten by the National Research Council and the Alumni Research Foundation. Several well-known scientists have accepted invitations to speak during the sessions. Clinicians, chemists, biologists, agricultural specialists, and others who are interested in attending the entire symposium will be accommodated at the Elizabeth Waters Dormitory on the Wisconsin campus. The cost for both room and board will be \$16.25. Reservations may be made with Dr. Henry Lardy, Biochemistry Department, University of Wisconsin, Madison 6. A more detailed announcement of the program will be made at a later date.

The 9th annual meeting of the Association of Southeastern Biologists was held at the University of Florida, Gainesville, on April 16-17. This was a joint meeting of the Association and the Southeastern Section of the Botanical Society of America. Elon E. Byrd, secretary-treasurer, reports that 195 members and visitors, representing 11 states and the District of Columbia, registered, and that 58 educational institutions and organizations were represented. Forty-six papers were presented before the group in four sessions. Seventy-one applicants were elected to membership in the Association.

The Association's annual banquet, held at the Florida Union Banquet Hall, was attended by 198 members and guests. Samuel L. Meyer, University of Tennessee, served as toastmaster. The address of welcome was given by John S. Allen, vice-president, University of Florida; greetings from the Florida Academy of Sciences were presented by George F. Weber, University of Florida; and Howard M. Phillips, chairman of the Southeastern Section of the Botanical Society of America, presented the officers of that group. The Research Prize of \$50.00, sponsored by the Carolina Biological Supply Company, was awarded to Shirley H. Taylor, of the Botany Department, University of Tennessee, for her paper on "Anatomical and Cytological Study of the Gall of *Aylax glechomae* on *Nepeta hederacea*";

George C. Kent and M. Jack Liberman, Louisiana State University, received honorable mention for their paper, "Induction of Psychic Heat in Ovariectomized Hamsters With Progesterone and Its Increased Effectiveness When Administered Centrally via the Brain Ventricles." The main address of the evening was given by the Association's retiring president, Martin D. Young, National Institute of Health, U. S. Public Health Service. Dr. Young's topic was "An Evaluation of the Foreign Malaria Introduced Into This Country by Returning Troops."

Officers of the Association for the year 1948-49 are: president, Samuel L. Meyer, University of Tennessee; president-elect, Howard M. Phillips, Emory University; vice-president, Eugene P. Odum, University of Georgia; secretary-treasurer, Elon E. Byrd, University of Georgia. Margaret Hess, Winthrop College, and Everett L. Bishop, University of Alabama, are newly elected members of the Executive Committee.

The 1949 meeting of the Association will be held at Knoxville, Tennessee, on April 15-16, the University of Tennessee serving as the host institution.

**The Wisconsin Academy of Sciences, Arts and Letters** held its 78th annual meeting April 23-24 at Central State Teachers College, Stevens Point, Wisconsin. Twenty-three papers were presented at the regular Academy sessions and 10 by the Junior Academy section.

The presidential address was delivered by L. E. Noland, whose subject was "Problems and Opportunities of a State Academy in These Times of Increasing Specialization."

For long and meritorious service to the Academy, George M. Reed, of the Brooklyn Botanical Garden, Brooklyn, New York, H. J. B. Thorkelson, of Madison, Wisconsin, George Wagner, of Palo Alto, California, and Rollin H. Denniston, of Madison, were elected to life membership.

Those elected to office for the 1948-49 Academy year are: Otto Kowalke, Department of Chemical Engineering, University of Wisconsin, president; E. L. Bolender, Superior State Teachers College, vice-president in science; Donald Anderson, Madison, vice-presi-

dent in arts; Robert K. Richardson, Department of History, Beloit College, vice-president in letters; Banner Bill Morgan, Department of Veterinary Science, University of Wisconsin, secretary-treasurer; H. O. Teisberg, State Historical Library, Madison, librarian; and L. E. Noland, Department of Zoology, University of Wisconsin, representative on the Council of the AAAS. Members were also named for the Library, Membership, and Publications Committees.

**The American Oil Chemists' Society**, at its recent annual meeting in New Orleans, elected C. P. Long, Procter & Gamble Company, Cincinnati, president; V. C. Mehlenbacher, Swift & Company, Chicago, first vice-president; G. A. Crapple, Wilson & Company, Chicago, second vice-president; J. R. Mays, Jr., Barrow-Agee Laboratories, Memphis, third vice-president; L. B. Parsons, Lever Brothers Company, Cambridge, Massachusetts, fourth vice-president; H. L. Roschen, Swift & Company, secretary; and J. J. Vollertsen, retired chief chemist, Armour & Company, Chicago, treasurer.

R. T. Milner, of the Northern Regional Research Laboratory, Peoria, Illinois, was appointed editor of the *Journal of the Society* (formerly *Oil & Soap*), to succeed Mr. Roschen, editor since 1937.

**The 95th annual meeting of the New Orleans Academy of Sciences** was held at Tulane University April 30-May 1, at which time the Academy met jointly for the second time with the Louisiana Academy of Sciences. The retiring president, Joseph C. Morris, presided at the business meeting at which officers for 1948-49 were elected, as follows: president, T. T. Earle, Tulane University; vice-president, L. J. Strohmeyer, Loyola University; secretary, Walter G. Moore, also of Loyola; treasurer, J. K. Reiss, of Tulane; and curator, G. F. Taylor, of Tulane. The technical sessions of the two Academies met in 5 sections, a total of 72 papers being read. Two symposia, one on Biophysics and the other on Electronics, were featured on the program.

Secretary Moore reports that the 1948 Research Grant, contributed by

the New Orleans Academy and the AAAS, was awarded to James M. McArthur, supervisor of Agriculture and Gardening, Orleans Parish School Board, for studies in plant propagation, and particularly for a comparative study of plant growth regulators.

The principal speaker at the annual banquet, held on the evening of April 30, was Michael M. Mora, director of World Trade Development, International House, New Orleans.

**The 58th annual meeting of the Ohio Academy of Science**, held at the University of Toledo on May 6-8, was very largely attended, and 140 new members were admitted to the Academy. A. W. Lindsey, of Denison University, retiring president, addressed the group on "The Fallacy of Communism."

Newly elected officers are: president, George B. Barbour, University of Cincinnati; secretary, Rush Elliott, Ohio University; and treasurer, W. M. Tidd, Ohio State University.

The 1949 annual meeting will be held at Miami University, Oxford, Ohio.

**The American Institute of Chemists**, at its Silver Anniversary meeting, May 7, in New York City, elected Lawrence H. Flett, director of the New Products Division, National Aniline Division, Allied Chemical and Dye Corporation, New York City, president; Raymond E. Kirk, head of the Department of Chemistry and dean of the Graduate School, Polytechnic Institute of Brooklyn, vice-president; and the following councilors: M. L. Crossley, director of research, American Cyanamid Company; James R. Withrow, professor of chemical engineering, Ohio State University; and John M. McIlvain, Research and Development Department, Atlantic Refining Company. Lloyd Van Doren, chemical consultant with Watson, Bristol, Johnson & Leavenworth, New York City, and F. A. Hessel, president of the Montclair (New Jersey) Research Laboratories, were re-elected secretary and treasurer, respectively.

**The Four-College Genetics Conference**, organized four years ago under the joint auspices of Smith, Amherst, and Mount Holyoke Colleges and the University of Massachusetts,



completed the year with a graduate student session on the Smith campus, May 20. The session, at which 16 graduate students reported on data collected for Master's and Doctoral degrees in the biological sciences, was conducted by S. L. Doeringhaus, research fellow in the Smith College Genetics Experiment Station. In addition to the 16 papers, each limited to 6 minutes, Hope Handler, Smith senior and candidate for honors in botany, presented a paper on "Triploid Hybrids in Three Species of *Datura*," based on work done in the Genetics Experiment Station under Albert F. Blakeslee.

During the college year each of the participating institutions is host to the conference twice. Except for the final program, which is usually devoted to the work of student members, speakers may include faculty or staff members of the colleges or may be invited speakers from elsewhere.

## NRC News

A group of leading chemists, physicists, and mineralogists, whose interests make them specially qualified, has recently been appointed by the NRC to act as Provisional Executive Committee of the American Section of the International Union of Crystallography. This Union, which was formed in 1947, has undertaken the publication of an international journal of crystallography, *Acta Crystallographica*, and is planning for the continuation of the *Strukturbericht* and for the publication of a new edition of the International Crystal Structure Tables. The Union's first General Assembly and Congress will be held at Harvard University from July 28 to August 3. The membership of the American committee consists of L. O. Brockway, University of Michigan; M. J. Buerger, Massachusetts Institute of Technology; J. D. H. Donnay, The Johns Hopkins University; I. Fankuchen, Polytechnic Institute of Brooklyn; C. Frondel, Harvard University; D. Harker, General Electric Company; M. L. Huggins, Eastman Kodak Company; A. L. Patterson (chairman), Bryn Mawr College; L. Pauling, California Institute of Technology; F. Seitz, Carnegie Institute of Technology; A. N. Winchell, American Cy-

anamid Company; and R. W. G. Wyckoff, National Institute of Health. This committee will act as advisory body to the NRC on the relationships between the crystallographers of the United States and the new Union. In addition to these duties, the committee will recommend to the NRC a permanent constitution for the American Section of the Union and will also advise the Council with regard to any matters which are of general concern to crystallographers in the United States.

Sweden is participating actively in the Pioneer Centennial to be celebrated in our Middle West this summer by inviting four prominent Swedish-Americans on a month's visit to that country. According to the American-Swedish News Exchange, the four who have been chosen are: R. G. Gustavson, chemist, who is chancellor of the University of Nebraska; Howard Hanson, one of America's leading composers; E. F. W. Alexanderson, who recently retired from his position as consulting engineer with the General Electric Company; and John O. Christianson, of the University of Minnesota's School of Agriculture. Drs. Gustavson and Alexanderson will lecture before appropriate groups in Sweden, while Dr. Christianson plans to study the organization of Swedish agriculture and the teaching of farming.

A new bimonthly bulletin intended "to convey to the physician in brief, meaty form, the results of important researches in the varied fields of cancer" has appeared under the sponsorship of the Texas Cancer Coordinating Council, the Cancer Committee of the State Medical Association of Texas, the Texas State Department of Health, the Texas Division of the American Cancer Society, and the M. D. Anderson Hospital for Cancer Research, University of Texas. Editorial offices of the *Texas Cancer Bulletin*, of which Russell W. Cumley is executive editor, are located at the M. D. Anderson Hospital. U. S. subscription price for one year is \$4.00. The bulletin, with its series of timely articles, will attempt to familiarize the family doctors with the symptoms of cancer and to

bring before them a working knowledge of its treatment.

The Electron Microscope Society of America has set up a Placement Service for the mutual benefit of its members and potential employers. The Society has on its membership roll the names of virtually every active electron microscopist in this country. Employers seeking scientists or technicians for work in this or allied fields are invited to make use of this Placement Service. Inquiries should be directed to the secretary of the EMSA, Dr. C. J. Burton, American Cyanamid Company, Stamford, Connecticut.

## Make Plans for—

III Interamerican Cardiological Congress, June 13-17, Michael Reese Hospital, Chicago, Illinois.

Association for Research in Ophthalmology, June 21-22, Northwestern University Medical School, Chicago, Illinois.

American Physical Society, 286th meeting, June 21-23, University of Wisconsin, Madison; 287th meeting, June 24-26, California Institute of Technology, Pasadena.

American Medical Association, annual session, June 21-25, Chicago, Illinois.

American Society for Testing Materials, June 21-25, Detroit, Michigan.

National Colloid Symposium, June 23-25, Cambridge, Massachusetts.

American Astronomical Society, June 28-July 1, Mount Wilson Observatory, Pasadena, California.

International Congress of Genetics July 7-14, Stockholm, Sweden.

American Veterinary Medical Association, August 16-19, Palace Hotel, San Francisco, California.

A visit to the David W. Taylor Model Basin while you are attending the—

★ AAAS  
Centennial Celebration  
Washington, D. C.  
September 13-17, 1948 ★

# Comments and Communications

## Toward a More Convenient Method for Expressing the Concentration of Biological Fluids

This is to call attention to a method of designating biochemical concentrations which is both erroneous and anachronistic. The designation in point is the term milligram percent. This "unit" is not comprehensible *a priori* and is inadequate for expressing present concepts in enzymology, pharmacology, and biochemistry. Since modern clinical medicine is becoming more and more dependent on these fundamental subjects, it follows that medicine, too, will begin to find this term inadequate.

In clinical biochemistry it has become customary to express the concentration of the more common inorganic ions in terms of milliequivalents per liter. This practice is commendable, and it is to be hoped that the custom will be extended to include iron, iodine, sulfur, phosphorus, and the rest of the ions currently determined.

With the precedent already established, it now becomes adventitious to extend the same principle to organic compounds and express their concentration in terms of millimols per liter. The enzymologists are currently following this practice, and even some pharmacologists are beginning to envision the action of certain drugs on the basis of molecular action. Competitive inhibition illustrates the wisdom of such thought.

In tracing the course of a metabolite through an organism one can easily calculate ratios between successive products and form a rough idea as to lability or metabolic pool size. This could then form a point of departure for more rigorous mathematical treatment. For example, the decomposition of 1 millimol per liter of acetoacetic acid could give rise to 1 millimol per liter of acetone. In corresponding units 10.2 mg% of acetoacetic acid would give 5.8 mg% of acetone. Any resemblance in the latter case is, of course, purely coincidental.

The term "normal" as applied to a chemical solution is a rather unfortunate choice of words, and it has been suggested by the present author (*J. chem. Educ.*, 1947, 24, 200) that it be replaced by the term "equant," abbreviated E. The word, equivalent, could then be abbreviated Eq, and a 1-E solution would contain 1 Eq/l. Such terminology would suffice for most solutions of inorganic ions.

Organic compounds in solution could then be described in terms of molarity. Thus, a solution could be called molar (M), millimolar (mM), or micromolar ( $\mu$ M). Unfortunately, the abbreviation mM has been used by some authors to mean millimols. A more consistent designation would be: Mols, mMols, and  $\mu$ Mols.

One of the chief disadvantages of changing from milligram percent to millimolarity is the unfamiliarity with

physiological levels in the new form. However, a few studies using the new expressions will quickly establish familiar landmarks. Since it is almost inevitable that the older terminology will become more and more inconvenient, immediate adoption of the newer expressions will shorten the period of confusion.

The recalculation of older data is quite simple, since, to convert from milligram percent to millimolarity, one merely divides by 1/10 the molecular weight. For the reverse transformation one multiplies by 1/10 the molecular weight. If the mM range is too large or too small, one can pass to the  $\mu$ M or M ranges, an advantage not enjoyed by the dubious expression, milligram percent. When calculating dilutions, one cannot deprecate the ease of handling concentrations in terms of molarities.

Habit will, of course, prejudice clinicians and old-line biochemists against the acceptance of the units here suggested. Chemists and investigators of metabolic problems should be quick to see the advantage of the "new" system. Should the staid editors of scientific journals eventually succumb to this heresy, the transition would be complete.

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## Bird Navigation in Homing and in Migration

The recent paper by Griffin and Hock (*Science*, April 2, pp. 347-349) provides valuable confirmation of the hypothesis earlier set forth in detail by Griffin (*Quart. Rev. Biol.*, 1944, 19, 15-31) that homing of birds can be explained, at least in large part, by random searching until familiar territory is reached. It is therefore unfortunate that they have confused the issue by speaking of navigation in migration as if it were clearly the same phenomenon as that displayed in homing.

Actually, there is little or no evidence that these two forms of navigation have the same basis, and, as Rowan (*Science*, August 24, 1945, pp. 210-211) has indicated, there is abundant evidence that they are entirely unrelated phenomena. Homing, if we accept Griffin's considerable body of evidence, is an acquired skill operating through what Griffin terms topographical memory. That it is gradually developed through prolonged experience is well recognized, at least for the racing pigeon. On the other hand, migration (as the term is commonly used, referring to a regular seasonal movement between breeding and wintering grounds that are far removed from each in latitude) appears in many birds to be a strictly inherited tendency. Rowan cites ample cases in support of this view.

This distinction is of great importance in any attempt to assess the endurance and long-range flying speed of birds. If flight direction in migration is instinctive, we may expect many such flights to be completed much more expeditiously than most of the homing flights cited by Griffin. Many flights are geared to the progress of the season or the abundance of food; but when flights are made over unattractive country or over water, we may



expect them to be direct within the limits of the navigational mechanism. The data on such flights are fragmentary, for it is seldom that the exact times of departure and arrival can be determined; but many long oceanic flights seem to be made at speeds considerably above the trifling rates generally found in homing tests, which may be construed as added support for the distinction between homing and migration.

Rowan's (*Trans. roy. Soc. Canad.*, 3rd Ser., Sec. V, 1946, 123-125) test with American crows from Edmonton, released 720 miles to the east, at Portage la Prairie, and Rüppell's (*J. Orn. Lpz.*, 1944, 92, 106-132) later work in Europe with the hooded crow indicate that in these species the inherited tendency is to fly a particular compass course or series of courses and not merely to fly to a particular point. It is unfortunate that in this particular test of Rowan's the returns were so low. If they had been more numerous, the test might have finally disposed of the hypothesis that migrating birds orient themselves by sensitivity to the earth's magnetic field; for the angle that Edmonton and Portage subtend to the magnetic north pole is quite large, and any orientation of the birds dependent on the magnetic field should presumably have been appreciably different at the two places. Ising's (*Arch. Math., Astron., Fys.*, 1946, 32A, No. 18) suggestion that the navigational mechanism in migration may be explained by sensitivity to the effects of the Coriolis force on the semicircular canals of the inner ear has at least a sound theoretical basis, but Thorpe and Wilkinson (*Nature, Lond.*, 1946, 158, 903-904) have shown that there are serious practical difficulties to be overcome before such an explanation can be accepted.

It is likely that the lack of an acceptable explanation of migratory navigation has tempted some workers to ascribe it to reaction to the prevailing wind or to visible aids such as landmarks or the direction of the sun. The inherited tendency in many migrants is certainly remarkable, though perhaps not more so than the habit of building a particular form of nest, but it seems beyond belief that it should enable an unaccompanied young bird to make use of landmarks; and the crow experiments cited above show that this explanation is inapplicable to these birds. Long periods of unbroken overcast over many areas of ocean and the extreme variations in wind speed and direction over short periods make it inconceivable that these factors could provide the basis for the astonishingly precise landfalls made by numbers of oceanic birds in particular. It is possible that no single mechanism will be found to be generally applicable, but I feel that Ising's hypothesis merits the most careful examination because it seems to be the only one capable of explaining a large number of cases. In the meantime, much may be learned from the observational approach. If some transoceanic migrant could be followed by airplane or radar from the start of its flight, we would at least learn whether it starts on course and would accumulate sorely needed information on the speeds maintained on such flights. The golden plover, in its autumn migration, flies from Nova Scotia to Brazil, often apparently without sighting land; and it is possible that it may continue on

across the Brazilian jungle without a halt until it reaches open country. If some of the spectacular migration flights such as this could be followed for even the first few hundred miles, we would add greatly to our inadequate knowledge of them.

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### Physical Basis of Bird Navigation

A paper by H. L. Yeagley (*J. appl. Phys.*, 1947, 18, 1035) on the above subject describing experiments with homing pigeons is a stimulating and provocative contribution to a little understood phenomenon of nature. It has already given rise to three rejoinders by physicists (J. Slepian. *J. appl. Phys.*, 1948, 19, 306; R. H. Varian. *J. appl. Phys.*, 1948, 19, 306; L. Davis. *J. appl. Phys.*, 1948, 19, 307).

I write mainly on the question as to whether birds are sensitive to magnetic fields and to their gradients. During the war the sweeping of magnetic mines called for the setting up of intense magnetic fields over a considerable area. Elementary calculations show that these fields far exceed in magnitude those which would be met with under ordinary conditions. The same is true of the gradients of the fields. Moreover, these fields extend to considerable distances below and above the surface of the sea. The complete absence of any effect on fish and on birds was apparent to everyone who had to deal with mine-sweeping.

If birds were guided in their navigation by geomagnetic phenomena, it would be expected that their behavior would be affected when they flew within several hundred yards of minesweepers. Yet nothing of the sort has so far been observed with such migratory birds as herring gulls and ducks or with nonmigratory birds. In many of the sweeping areas birds were rare, even though sillage was thrown out. When present, birds appeared to be supremely indifferent to magnetic fields, even at the sudden beginning of magnetic pulsing. A sweeper might pass close to a group of gulls or ducks sitting quietly on the water, yet they would completely ignore any surprise which man might provide except for food. Again, a flight of ducks might pass over the sweep with no sign of tailspin!

The hypothesis that electromotive forces set up in the body of a bird by flying through a magnetic field would excite some sensory mechanism which would help the bird in navigation does not seem plausible in view of the great variation of electric fields existing in the atmosphere. Again, the effects of the earth's rotation as manifested by the Coriolis force are small compared with gravity but still large enough to be given consideration. However, the requirements of level flying on the part of the bird seem to be excessive if the earth's rotation is to play a part in bird navigation.

The only other explanation within the ken of physicists seems to be along the lines of such things as the elevation of the sun, the stars, and the use of prevailing winds. The eyesight of birds is known to be greater than that

of men, and it is possible that even in daylight the stars may be an aid. Also, their sense of terrain is probably better than that of all save the most experienced humans. There seems to be little reason to throw overboard the simple elements of navigation which are already known.

It is well to consider the opinions of experienced biologists and physiologists and to reflect on how much is taken for granted which has not been confirmed by facts. A recent paper by Griffin and Hock (*Science*, April 2, pp. 347-349) gives results of observations from an airplane on the flight of gannets released from a point over 200 miles inland from their nests near Gaspé, P. Q., and over 100 miles from the nearest salt water. The observed flight paths spread out from the release point in what appeared to be random directions, and the results suggest that the gannets were exploring until they could pick up a familiar coastline on the west side of the Gulf of St. Lawrence. When it comes to migratory flights at the appointed season, there comes to mind the fall flight of woodcocks, which crowd into the western part of Nova Scotia before taking off over the Bay of Fundy to New England on a flight of some 200 miles. Still more remarkable are the migrations of hummingbirds, possibly over the same route. In both cases nothing is apparently known as to the directness of their flight over a long sea distance. More facts are obviously needed. From Dr. Yeagley's curves showing the geomagnetic and geographical latitudes over the North American Continent, it is tempting to assume that the well-known migratory paths of geese, brant, and ducks in the East and in the West follow lines along which the two latitudes cut at the greatest angle. Here again an alternative and simpler explanation lies in topographical recognition. If scientists are to avoid taking refuge in the term "instinct" as a way of saying that they do not know, it is clear that more experimental evidence is needed.

I wish to express my grateful thanks to Ralph M. Meredith and to Harold Beament for helpful discussion and letters. Both served as Commanding Officers of HMC Minesweepers during the war, and their accumulated experience has been of great help. I also wish to thank Capt. A. F. Peers, RCN, for his kindly aid and advice.

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### Microbiological Assay or Bacterimetry?

Within the last few years there has originated a new branch of analytical chemistry generally referred to as "microbiological assay" or "microbioassay." With regard to convenience and descriptiveness, these terms seem poorly suited. Through long usage the parent term "biological assay" has been linked to the concepts of drug and potency and tends toward a semiquantitative connotation. According to Hackh (*Chemical dictionary*, 1944), biological assay is "the determination of the active principles of a drug by determining the smallest quantity which will produce certain symptoms in animals," and a similar definition is found in the 1946 edition of Web-

ster's dictionary. This definition, modified in accordance with the prefix micro-, seems hardly adequate to cover a system of methods which, in principle, can determine any substance affecting the growth of a microorganism as a nutrient or otherwise, and which already today, at an early developmental stage, does so in selected cases with an accuracy superior to that of nonbiological methods. In writing and speaking, the current terms are cumbersome, because of length and lack of flexibility in the formation of adjectives or adverbs. It would seem from more than one point of view that a simpler term, and one that is not encumbered by pre-empted connotations, would fill a need. Perhaps even a family of terms, to cover both the general and the specific aspects of the new field, would be useful.

Established branches of analytical chemistry are gravimetry, colorimetry, acidimetry, oxidimetry, iodimetry, etc. Many other analogous terms have gained usage, e.g. calorimetry, chlorimetry, fluorimetry, polarimetry, turbidimetry, or amperometry, conductometry, dilatometry, or manometry. The choice between the -imetry and -ometry endings seems to be fluid in many cases (iodimetry and iodometry, saccharimetry and saccharometry, etc.), while in other instances it seems to be based on etymology (conductometry, dilatometry, spectrometry) or perhaps euphony. However, a tendency, as yet uncodified, seems to exist to use the two endings for purposes of distinction, i.e. an "-ometer" seems to be preferentially an instrument for the determination of a property or substance, the corresponding "-ometry" being devoted to these measurements in their own right, while an "-imeter" and "-imetry" deal with a property merely as a means to a general analytical end. Perhaps "saccharometry" and "colorimetry" serve well to exemplify this distinction. It may serve the ends of clarity and consistency to follow the existing trend, in giving preference to the "-imeter" and "-imetry" endings in connection with the analytical tool. As to possible conflicting claims of etymology and systematics, the latter have often before been given preference in matters of chemical terminology.

The writer would like to propose the term "bacterimetry," analogous to gravimetry, colorimetry, etc., to replace "bacterial microbiological assay." Most of the microbiological analytical methods now in use employ bacteria. If, in the future, methods based on true fungi or protozoa should be broadly developed, "fungimetry" and "protozoimetry" may be added to the practical biochemical dictionary. As a more comprehensive term for the new branch of analytical chemistry, "bionimetry" or "biotimetry" may be considered, the writer tending to prefer the former because of its placing the accent on the means of analysis (bions) rather than on its objects (biotics). In line with the suggested considerations, "isotopimetry" could serve to label another newcomer in analytical chemistry, viz., the isotope dilution method. Growth in science demands a growing vocabulary.

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# TECHNICAL PAPERS

## The Amino Acid Requirements of Swine: Tryptophan<sup>1</sup>

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It is common knowledge that swine require proteins of high biological value for maximum growth and efficiency of food utilization. However, no studies have as yet been reported on the amino acids that are essential for the growing pig. Research on amino acid requirements has been confined largely to the rat (10), chicken (1, 3) dog (14), mouse (2), and man (11-13). Studies on the amino acid requirements of swine have been delayed until purified rations could be developed that would support normal growth in pigs. The research of Hughes (5, 6), Hughes and Ittner (7), McRoberts and Hogan (9), Winrobe, *et al.* (15, 16), and Heinemann, *et al.* (4) has contributed substantially to perfecting purified diets that will meet the nutritional needs of the pig. Our modification of these diets has resulted in a purified ration which will produce a growth rate superior to a balanced natural feedstuff diet, thus permitting the study of amino acid requirements.

Recently, Luecke, McMillen, Thorp, and Tull (8) have demonstrated a relationship between nicotinic acid and tryptophan for the growing pig. Their results indicate that when corn constitutes a major part of the ration, nicotinic acid deficiency occurs. The addition of either 30 mg of nicotinic acid daily/pig or 200 mg of DL-tryptophan alleviated the deficiency and gave a growth response. It is not clear whether tryptophan promoted this response by serving as a precursor for nicotinic acid or by some other mechanism. Our studies show conclusively that tryptophan is an essential amino acid for the growing pig, even in the presence of adequate nicotinic acid.

To identify tryptophan as an essential amino acid, it was necessary to design a purified diet adequate in all the known nutrients with the exception of tryptophan. This was accomplished by modifying the diet previously reported by Heinemann, *et al.* (4). The tryptophan-low diet was composed of hydrolyzed fish protein (26.1%), dextrose (30.2%), dextrin (25.0%), lard (11.0%), mineral mixture (5.2%), cellulose (2.0%), and liver extract (0.5%). The water-soluble vitamins were added to the

diet in the same quantities as listed by Heinemann, *et al.* (4), except that thiamin chloride was fed at a level of 0.40 mg/kg of live weight/pig daily. Each pig was fed 1,500 I.U. of vitamin A, 200 I.U. of vitamin D, 50 mg of  $\alpha$ -tocopherol, and 2 mg of vitamin K daily. The hydrolyzed fish protein was chemically treated by a special process to remove most of the tryptophan. DL-tryptophan was added to the control diet (group A) at a level of 0.4% of the total ration. This level was apparently adequate to meet the tryptophan requirements of the growing pig.

Four male and four female purebred Duroc weanling pigs averaging 50 lbs were paired for this experimental study. All the pigs were closely related and had the same treatment prior to the starting of the experiment. The pigs were kept in individual pens equipped with raised wire-screen floors and were fed twice daily in amounts to satisfy the individual appetites of each animal. An adjustment period of 7 days was allowed for changing the pigs gradually from a natural grain ration to the experimental diets.

The control animals (group A—four pigs) receiving the purified ration plus 0.4% of DL-tryptophan made an average daily gain of 1.42 lbs for a period of 28 days after the adjustment period. These pigs had glossy, smooth hair coats and showed no outward signs of ill health or unthriftiness. Twenty-eight days after the adjustment period the pigs averaged 96 lbs in weight and were removed from the experiment. In a previous experiment, similar pigs on a balanced ration of natural feedstuffs gained 1.25 lbs/pig daily, which indicated that our purified diet plus 0.4% DL-tryptophan supported growth better than the natural grain ration.

The pigs (group B—four pigs) receiving the tryptophan-deficient diet showed a weight loss averaging 2.13 lbs/pig at the end of the first week on the purified diet, while those receiving 0.4% DL-tryptophan gained an average of 8.9 lbs in the first week. These data definitely show that the lack of tryptophan in the diet of the pigs has an immediate retarding effect on growth rate.

Two pigs kept on the tryptophan-deficient diet for 21 days lost an average of 5.5 lbs during that period and showed considerable reduction in appetite, rough hair coat, and severe symptoms of inanition. After 21 days, 0.4% DL-tryptophan was added to the diet. This caused an immediate increase in food consumption and resulted in a growth rate of 1.47 lbs/pig daily for the remaining 19 days of the experiment. The animals took on a more thrifty, healthy appearance, and gradually the gloss returned to the hair coat.

The other two pigs were kept on the tryptophan-deficient diet for 14 days, after which 0.4% DL-tryptophan was added. Prior to the addition of tryptophan the pigs lost 3.5 lbs in 14 days; after tryptophan was added there

<sup>1</sup> Contribution from the Departments of Animal Husbandry and Agricultural Chemistry, Journal paper No. 335, Purdue University Agricultural Experiment Station.

<sup>2</sup> The authors are grateful to Eli Lilly and Co., Indianapolis, Indiana, for the hydrolyzed fish protein and liver extract used in this study, and to A. Lee Caldwell and George Schnakenberg, of the Lilly Research Laboratories, for the preparation of tryptophan-free hydrolyzed fish protein.

was an average gain of 1.06 lbs daily for 26 days. The improvement in appearance was similar to that previously described.

The above data show that tryptophan is an indispensable amino acid for growing pigs. In addition, a purified ration has been formulated which is capable of producing a rate of growth equal to that obtained on a well-balanced mixture of natural feedstuffs.

The complete details of this experiment will be published in a later paper.

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### *Trypanosoma cruzi* Endotoxin (KR) in the Treatment of Malignant Mouse Tumors<sup>1</sup>

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Verification of the results of Roskin and Klyueva (7 and several earlier papers) in producing the cancerolytic toxin, KR, from the lysed cells of *T. cruzi* was recently claimed by Malisoff (8). Since this mode of "biotherapy" is still looked upon by some as one of the promising leads in the treatment of cancer, our own largely negative findings are outlined here for the sake of critical comparison.

Since March 1945, 8 different strains of *T. cruzi* have been tested by us against 5 varieties of malignant tumors in over 1,300 experimental mice. The trypanosomes covered a wide range of virulence and were originally derived

<sup>1</sup> Our experiments, conducted under a grant from the National Cancer Institute, represent one aspect of a broad joint-institutional research program on chemotherapy of cancer, initiated and organized by Murray J. Shear. We are indebted for the technical assistance of Mrs. Jean Palmquist and Miss Elizabeth Brown. Various strains of *T. cruzi* were kindly supplied by Mrs. Eleanor Johnson Toble (National Institute of Health), Cecil A. Hoare (Wellcome Laboratories of Tropical Medicine, London), and Malcolm H. Soule (University of Michigan).

from various mammalian and insect hosts (man, monkey, armadillo, triatome). Included among the 8 *T. cruzi* strains were the "Soule" strain ("S" strain), on which Malisoff based his positive data, and the "Wellcome" strain ("W-BH" strain, inadvertently referred to as the "R" strain in an earlier publication, 4). The latter material was the source of Roskin and Klyueva's allegedly effective KR preparations. The tumors were: transplantable sarcomas 37 and 180 in Swiss and A-mice; transplantable squamous cell carcinoma 119 in A-mice; transplantable and spontaneous mammary adenocarcinoma in C3H- and dba-mice.

Infections of mice with the various *T. cruzi* strains, as active Chagas' disease, resulted in consistent inhibition of tumor growth, but produced very few tumor regressions and generally did not lengthen the life of infected cancerous mice beyond that of controls (5, 6). Tumor inhibition was sometimes accompanied by loss in body weight. These weight losses were closely correlated with the graded virulence of the several trypanosome strains.

The parasites were not "positively tumorotropic," as stated by the Russian investigators who found leishmanial stages in malignant growths to the exclusion of normal host tissues. Under our experimental conditions cancer cells proper were only rarely parasitized. The infection was lightly present in the stroma of some tumors and was heavily concentrated in heart, liver, spleen, kidneys, small intestine, and skeletal muscle.

Cancerous mice infected with the always lethal W-BH strain died within 8-13 days of inoculation. Weight loss in these animals was considerable, and tumor growth was almost completely suppressed. When the infection in such mice was checked by drugging with the quinoline derivative, Bayer 7602, the previously inhibited tumors resumed their usual growth rate, and the hosts eventually died of cancer. From the available evidence, tumor inhibition by living *T. cruzi* does not appear to be a specific phenomenon caused by response to specific toxins, but can more adequately be attributed to competition for essential dietary factors and to general depletion of the host-system by the infection. Active Chagas' disease has, therefore, no clinical value in the treatment of malignant growths.

The killed trypanosome preparations of Roskin and Klyueva contained the "cancerolytic endotoxin," KR, which was claimed to have caused the complete regression of a variety of neoplasms in experimental rodents and in 13 out of 60 cancer patients. Follow-ups on the human cases treated are too brief for final appraisal, and evaluation is further confused by X-ray treatment in several instances. Duplicating as closely as possible the Russian techniques, we followed two general types of procedures:

(1) Cultures of *T. cruzi* (Brazil strain) at the height of growth were heat-killed by 30-min exposures to a temperature of  $49^{\circ}\text{C} \pm 1^{\circ}$ . This material was injected intraperitoneally into cancerous mice, or the tumor pieces were soaked in the preparation for 8 hrs prior to implanting. Injections were without effect, and the latter pretreatment did not reduce the number of "takes" or alter subsequent growth, as compared with an equal num-



of untreated controls (Table 1). Dosage was based on units, one unit being the equivalent of 1,000,000 killed trypanosomes.

KR stability by Roskin and Klyueva. The lysate was made under bacteriologically sterile conditions, and from 8 to 16 consecutive daily injections were given either

TABLE 1

Treatment	Total dosage (units)	Injections	Tumor	Mice (tests + controls)	% Growth of tests (contr. = 100)	Tumor Regressions		Deaths during expt.		Effect on test tumors
						Tests	Contr.	Tests	Contr.	
TESTS WITH HEAT-KILLED <i>T. cruzi</i> CULTURES :										
Heat-killed <i>T. cruzi</i> B strain from cultures	85-520	4-8 i.p.	Transpl. mammary	20 C3H—♀ ♀	97	0	0	1	0	None
	70	4 i.p.	Carc. 119	40 A—♂ ♂ + ♀ ♀	113	1	0	3	2	Ulcerated earlier
	1,050	15 i.p.	Spontan. mammary	96 dba—+ C3H—♀ ♀	88	3	1	21	17	None
Test tumors soaked in above for 8 hrs before implantation			Carc. 119	20 A—♀ ♀	96	0	2	0	0	Ulcerated earlier
			Transpl. mammary	20 C3H—♀ ♀	128	0	0	0	1	None
Summary				196	104	4	3	25	20	
TESTS WITH LYSED <i>T. cruzi</i> CONCENTRATES :										
Lysed <i>T. cruzi</i> B strain from cultures	600	16 s.c.	Carc. 119	20 A—♂ ♂ and ♀ ♀	144	0	0	2	6	None
Lysed <i>T. cruzi</i> W-BH strain from infected mice	300	8 s.c.	Carc. 119	20 A—♂ ♂ and ♀ ♀	120	0	0	9	1	Softening and necrosis
	600	11 s.c.	Spontan. mammary	20 dba—♀ ♀ and C3H—♀ ♀	68	1	1	Killed for tissue study		Hemorrhage, softening and necrosis
	850	14 s.c.	Carc. 119	20 A—♂ ♂ and ♀ ♀	117	0	0	1	0	None
Summary				80	112	1	1	12	7	
TESTS WITH "WHOLE CULTURE LYSATES" OF <i>T. cruzi</i> :										
Lysed <i>T. cruzi</i> S strain grown in NIH medium	1,120	28 11 s.c. 17 i.p.	Spontan. mammary	4 dba—♀ ♀		0	0	1	2	None
	"	"	Sarc. S-180 Sugiura	3 A—♀ ♀		1	1	1	2	"
	"	"	Carc. 119	13 A—♂ ♂ and ♀ ♀	92	0	0	3	3	"
Whole culture lysate <i>T. cruzi</i> S strain grown in NNN + Tyrode. Culture obt. from Malisoff	7	7	Carc. 119	28 A—♂ ♂ and ♀ ♀	Not measured	0	0	0	2	"
	"	"	Sarc. S-180 Sugiura	36 A—♀ ♀	"	0	0	18	18	"
	9	"	Sarc. T-180 Malisoff	44 Swiss—♀ ♀	119	10	12	12	10	"
Summary				128	105	11	13	35	37	

(2) Concentrations of *T. cruzi* centrifuged either from cultures of B-strain in NIH medium or from the plasma of mice bled at the height of infection with W-BH strain were lysed by the addition of neutral glass-distilled water and extracted at 1° C for 24 hrs prior to use. The age of lysate when injected ranged from 1 to 6 days, 10 days having been stated as the upper limit of

subcutaneously or intraperitoneally. This treatment produced no tumor regressions, but did occasionally result in damage to both neoplastic and normal tissues, especially liver and kidney. Mortality was greater among the treated mice than in the untreated controls (Table 1).

Malisoff (3) modified the Russian technique by adding distilled water and 1:10,000 Metaphen to whole cultures

of the S strain of *T. cruzi* grown on NNN medium with Tyrode overlay. These "whole culture lysates" were injected either intraperitoneally or subcutaneously and were quantitated to give the equivalent of about 1,000,000 lysed organisms/daily inoculum. We prepared such lysates from cultures received through Malisoff and from our own cultures of S strain. Among the various tumors tested (Table 1) were two lines of sarcoma 180; one obtained from K. Sugiura, of Memorial Hospital, and the other furnished and implanted in every case by the same technician who had supplied Malisoff with sarcoma T-180. The former tumor (Sugiura S-180) took and killed in all instances, while Malisoff's sarcoma T-180 regressed spontaneously in more than half of our controls.

Since the claims of Malisoff (8) are based on a total of only 43 treated mice and 15 controls, and since exact repetition of the T-180 experiments showed more than 50% tumor regressions in the untreated mice, all of Malisoff's results with sarcoma T-180 may be looked upon as spontaneous regressions. "Whole culture lysates" tested by us against spontaneous adenocarcinoma in 40 C3H- and dba-mice gave no sign of cancerolytic effect and did not prolong survival. On the contrary, deaths among the treated mice were more frequent than among the controls.

## Three New Polymorphs of Zinc Sulfide

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Three new polymorphs of ZnS have been recognized by the writers. All are related structurally to wurtzite, but differ in that they represent stacking sequences of hexagonal closest-packing of higher periodicity than that of the basic wurtzite structure. The new polymorphs correspond to 4H, 6H and 15R in the notation of Ramsdell (1) and are isostructural with the corresponding polymorphs of silicon carbide. Table 1 shows the crystallo-

Malisoff's use of the term "chemical purification" gives the misleading impression of a fractionating technique followed in preparing the cancerolytic principle. Actually, whole culture lysates are crude preparations, and failure of other laboratories to reproduce potent KR should not be ascribed to degree of refinement in procedure. As for the work of Roskin and Klyueva, it is still too early for final judgment; but in view of the almost wholly negative outcome of our experiments (5, 6) and those of others (1-3), the elusive "endotoxin" of *T. cruzi* does not at present appear to hold out much promise for cancer therapy.

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ties the several polymorphs are identical with wurtzite-2H. All have a distinct cleavage on {1120} and traces of cleavage on {0001}. The specific gravity, determined by a microbalance on a 20-mg sample composed largely of 4H, was 4.09, in close agreement with the calculated value of 4.121 for 4H. Sufficient material for a quantitative chemical analysis is not at hand, but the material probably contains at least several per cent of divalent iron in isomorphous substitution for zinc.

The crystals occur in shrinkage cracks in clay-ironstone (siderite) concretions embedded in a carbonaceous black shale of the lower Conemaugh formation at numerous localities in western Pennsylvania and eastern Ohio. As-

TABLE 1

	Wurtzite-2H	Wurtzite-4H	Wurtzite-6H	Wurtzite-15R
$a_0$	3.811 Å	3.806	3.813	3.822
$c_0$	6.234	12.44	18.69	46.79
$a_0 : c_0$	1 : 1.6358	1 : 3.268	1 : 4.902	1 : 12.242
Cell contents	$Zn_2S_2$	$Zn_4S_4$	$Zn_6S_6$	$Zn_{15}S_{15}$
Space group	C6mc	C6mc	C6mc	R3m

graphic properties, data for ordinary wurtzite (2H) being given for comparison.

The crystals of the new polymorphs are steep pyramidal in habit and are doubly terminated with the basal pinacoid present at the analogous pole only. Parallel intergrowths of 15R with 4H and of 15R with 6H were observed, the surfaces of juncture being uneven and approximately vertical in position. In physical proper-

sociated minerals are barite, sphalerite, chalcopyrite, pyrite, and calcite. The concretions and minerals therein apparently formed at essentially ordinary conditions of temperature and pressure during the diagenesis of the sediment. All three of the polymorphs occur side by side in rudely radial aggregates of single crystals, indicating simultaneous crystallization. Sphalerite is later formed than the polymorphs, and wurtzite-2H does not occur in the assemblage.

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<sup>1</sup> We wish to express our appreciation to David M. Seaman, of the Carnegie Museum, Pittsburgh, and Howard Hamilton, of Vandegrift, Pennsylvania, who found the original specimens and generously offered them for study.



# IN THE LABORATORY

## An Improved Radioactivity Measuring Cup<sup>1</sup>

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The usual laboratory procedure for the measurement of radioactivity in samples of either biological or chemical origin currently involves the preparation of a solution containing the active isotope and the placing of an aliquot of this material upon some type of flat, circular cup or planchet. Most of the containers employed for this have a diameter of the order of 1" and a depth of not over  $\frac{1}{4}$ ". This allows the sample to be placed as close to the counter window as the protective structure of the latter will admit and thus maximize the geometric advantage of the setup. It is frequently found, however, that when aliquots or liquid residues are pipetted onto the sample cup, surface tension causes the liquid to accumulate toward the periphery and, in the course of drying, often to creep over onto the outside of the cup. Apart from the sample loss and the contamination to handling forceps and cup holders which this may entail, the effect characteristically gives rise to a serious loss of uniformity in sample density over the cup area; this leads correspondingly to a varying degree of self-absorption in the sample. The latter will also depend upon the energy of emission, but may assume serious proportions, especially with soft beta emitters.

Labaw (1) has recently developed an inside multiple sample counter for soft beta emitters in which he employs a planchet consisting of a small brass disc (area,  $\sim 1.2$  cm<sup>2</sup>) cut from lathe stock. The face of this disc is grooved to give a series of concentric rings, and upon this surface the sample is pipetted and dried. By this technique Labaw has been able to obtain uniform sample densities to the extent of agreement between emission rates from subareas as small as 0.2 cm<sup>2</sup>.

Most specimen cups now available on the market are pressed from thin sheet metal such as copper, aluminum, or platinum, and the expedient to be described here is a modification of Labaw's method which will apply equally well to most of these containers. It entails the production of a series of concentrically placed, raised circular ridges

on the surface of the container by means of a suitably machined punch and die and press. On the face of the die is machined a series of concentric depressions, and on the counterpart a corresponding series of concentric raised rings. In addition, the receiver usually must be so designed as to fit closely the outer dimensions of the sample cup, especially for light metal cups with thin walls, in order to avoid distortion and warping of the sample cup during the stamping.

The die currently being used in this laboratory was machined from tool steel after the above manner and placed in an arbor press. It was found that, with a little practice, the plain sample cups obtained commercially could be stamped quickly to give the desired concentric circular embossments. The spacing for the rings produced by the particular die described here happened to be such that the outermost ring,  $1\frac{1}{16}$ " in diameter, surrounded two more concentric rings at  $\frac{3}{32}$ " intervals, leaving a central area  $\frac{5}{16}$ " in diameter. In the material used, the individual rings or embossments were approximately .015" in width and raised .010" from the floor of the cup. This proved sufficient to retain aliquoted material of 0.2-ml volume easily within the outermost ring and allowed it to dry uniformly over the surface without creeping. It was found that meticulously clean cups were essential and, further, that a drop of alcohol placed in the central space contributed materially to the uniform spreading and distribution of the sample over the surface.

By way of improvement, it is suggested that injection-molded plastic blocks, embossed as described here, might prove even more satisfactory in routine laboratory counting work, since backscatter would be reduced. This appears not yet to have been attempted, although a number of laboratories are now using plastic cups usually produced individually by turning from suitable round stock. This latter procedure, however, is so expensive as to discourage the convenient practice of discarding cups after a single usage, even though proper cleaning and checking are both time consuming and frequently futile.

Sample cups of the design reported here have been successfully used by the present authors in the measurement of P<sup>32</sup>, I<sup>131</sup>, and Co<sup>60</sup>, but have not yet been applied in studies with either C<sup>14</sup> or S<sup>35</sup>. No studies of backscatter characteristics have been made as yet to determine whether or not this factor is increased by the narrow raised ridges here described, and detailed study is needed of the self-absorption characteristics as a function of surface tension relative to ridge spacing and dimensions.

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<sup>1</sup>The opinions expressed in this article are the personal ones of the authors and do not necessarily reflect the official views of the Navy or the Naval Service at large. The mechanical features described here were designed and built by the authors at the Naval Medical Research Institute.

# A Turbidimetric Method for Determining the Effect of 2,4-D Upon the Growth of Yeast

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A considerable amount of work has been reported concerning the effect of 2,4-dichlorophenoxyacetic acid (2,4-D) upon the development or growth of plant tissues. The subject has been reviewed recently by Mitchell and Marth (1). In view of the widespread use of this substance as a herbicidal or herbistatic agent, a study of the mechanism of its action on plant cells seemed desirable.

TABLE 1  
TURBIDITY MEASUREMENTS OF YEAST CULTURES AT  
VARIOUS CONCENTRATIONS OF 2,4-D

Date	Concentrations of 2,4-D/ flask (ppm)	Per cent transmission			
		1	2	3	Average
10-10-47	Control*	19	19	18	19
10-25-47	Control	18	20	22	20
"	0.001	20	23	21	21
"	0.01	22	22	21	22
"	0.1	22	21	21	21
"	1.0	22	21	22	22
10-10-47	1.0	18	18	20	19
"	10	22	23	23	23
"	100	46	46	47	46
"	1,000	82	81	82	82

\* Control contains no 2,4-D.

Since growth and respiration are generally closely allied, it seemed plausible to use respiration as a means of studying the underlying mechanism of 2,4-D. In making such a study, it was thought desirable to run preliminary experiments on living yeast cells. This study could then serve as groundwork toward establishing the most effective concentration of 2,4-D to be used in experiments on mechanism. Yeast cells were selected (1) because of their ease of growth and manipulation and (2) because it is assumed that cell reactions of plants and animals, regardless of phylogenetic rank, generally are the same. In this particular phase of the work to be reported, the effect of 2,4-D on the growth of yeast is measured, by determining the turbidity of the medium, using a Cenco Photometer.<sup>1</sup>

Cultures of *S. cerevisiae* were grown on fort agar (2) slants at a pH of 4.8 and incubated for 48 hrs at 30° C. These were stored at 4° C. To 500 ml of a Czapek's solution were added 25 gm of glucose and 0.12 γ of biotin. Twenty-five ml of this solution was put into 15 125-ml Erlenmeyer flasks which were autoclaved at 15 lbs pressure for 15 min.

<sup>1</sup> Cenco-Sheard-Sanford "Photometer," Type C-5, Central Scientific Company, Chicago, Illinois.

A stock solution of 2,4-D was prepared at a concentration of 1,000 ppm, and from this, concentrations of 100, 10, and 1 ppm were prepared. All four concentrations were then autoclaved at 15 lbs pressure for 15 min.

The 15 sterile flasks containing the Czapek's solution were divided into 5 groups of 3 each. The first group served as the control (no 2,4-D). Each flask was then inoculated with yeast cultures and incubated at 30° C. At the end of 7 days, growth was determined by the turbidimetric method. A red filter was used throughout.

The results, as shown in Table 1, indicate that concentrations of 2,4-D from 10 to 1,000 ppm have the most effect upon the growth of yeast. Concentrations of 1 ppm have practically no effect. This finding was further substantiated when another batch of yeast was subjected to 2,4-D in which the concentration ranged from 0.001 to 1.0 ppm. The same procedure was used as described above. With the exception of one aberrant value, the results were similar, i.e. the same as the control.

The test described above, which is based on the assumption that growth is directly proportional to turbidity, is relatively simple and can be run in a comparatively short time.

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## A Simple Adaptation of the Mercury Calibration of Warburg Manometer Sets to Insure Interchangeability

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Almost anyone who has worked with the Warburg technique has experienced the irritation and delay which follows the breaking of a flask. Even with reasonable care, vessels do get broken, and unless one has extra sets, runs may be delayed until the flask has been repaired and recalibrated. This can be avoided by the use of flasks and manometers with interchangeable joints and an extra set of flasks. In this laboratory the most commonly used flask is the simple double-side-arm type, and extra flasks were procured to use either with a set of four Summerson manometers or as replacements on the other manometers. In planning the calibration of the glassware it was realized that, if the usual calibration methods were used, it would be necessary to calibrate each of these vessels both with its Summerson manometer and with its intended replacement manometer and that without a great deal of extra calibration interchangeability was strictly limited. To increase the interchangeability of flasks and manometers the following scheme was worked out.

Any flask in the replacement set is weighed empty and then filled, according to the method of Burris (1), with



enough mercury to rise about 1 cm above the flask into the manometer arm. The flask is placed on the dry joint of the first manometer of any one of the sets and sealed. A line is scratched with a diamond point at the top of the mercury column. The flask is removed and the temperature of the mercury recorded immediately. As quickly as possible, and making sure that the temperature of the mercury does not change and that no mercury is spilled or left on the manometer joint, one repeats this procedure with the remaining manometers, marking the height of the mercury with a diamond point on each. If the temperature of the mercury changes considerably during handling, it may be found advisable to record it after each manometer is marked, for future calculation. We found it simpler in the long run in such cases to wait until the temperature returned to the initial level. The flask and mercury are then weighed and the manometers calibrated from the reference mark in the usual manner.

From this point on it is only necessary to calibrate any flask to the reference mark on any one manometer to obtain the  $V_g$  for that flask in combination with any of the manometers. Complete interchangeability then becomes a simple matter of calculation of  $kO_2$  or  $kCO_2$  values from known  $V_g$  values for all combinations. Furthermore, broken flasks after mending or new types of flasks may be readily fitted into the scheme by a quick calibration against any one manometer.

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## A Simplified Apparatus for One-dimensional Paper Partition Chromatography

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In carrying out one-dimensional paper partition chromatography, Consden, *et al.* (1) make use of glass troughs of cylindrical shape which, held in a horizontal position, serve as reservoirs for the developing solvents into which the filter paper strip chromatograms dip. Longenecker (2) has recently described a way of making such troughs.

The present note describes a circular trough which is easily and cheaply made from the two halves of an ordinary Pyrex Petri dish, 3.5" in diameter. The centers of the two halves, with their lips facing upward, are connected by fusing them to a solid glass rod  $\frac{1}{8}$ " in diameter and 16.0" long. This can be done readily at low cost by any competent glass blower.

In the accompanying diagram (Fig. 1) the double trough so obtained is shown in place in a glass humidifying chamber. The bottom trough serves to contain water or any aqueous solution which provides the chamber with the necessary humid atmosphere and also serves to provide a base for support. Absorbent cotton is wrapped around

the solid glass rod and is wet with the same water phase present in the trough at its base. This cotton wick provides for the rapid restoration of equilibrium when it is necessary to open the humidifying chamber from time to time. The organic solvent used for development is placed in the upper trough. The paper strip chromatograms, suitably folded to dip into the organic solvent and to hang down from the trough, are held in place by a thin, solid, glass rod bent in a great arc. One end of the rod is turned perpendicularly to the plane of the arc and serves as a handle.

Around the circumference of the upper trough is placed a wire guard to hold the paper strips away from the side

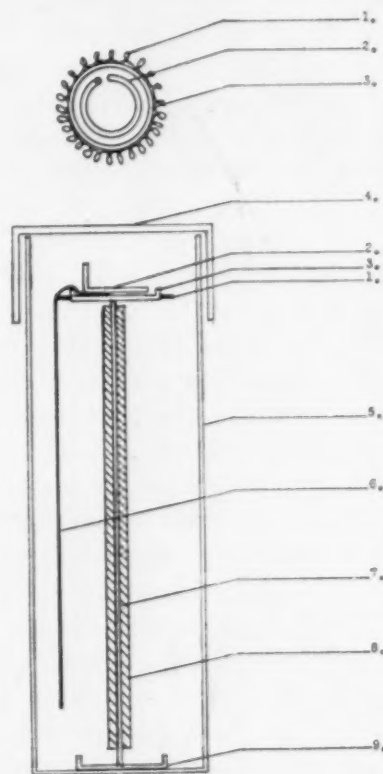


FIG. 1. Diagram of apparatus: (1) stainless-steel wire guard, (2) glass retaining rod, (3) Petri dish, (4) crystallizing dish, (5) cylindrical glass jar, (6) chromatogram strip, (7) glass rod, (8) absorbent cotton, (9) Petri dish.

of the trough over which they hang. This wire guard is made by bending a stainless-steel wire to form a scalloped circle (see Fig. 1) which has sufficient spring tension to grip the sides of the Petri dish trough so that no other means of attachment is necessary.

As a humidifying chamber, one may conveniently use a stock cylindrical glass jar, 18" high and 6" in diameter, covered by an inverted crystallizing dish (6.5" in diameter). The closure may be made gas-tight by applying a starch glycerine paste to the edge of the jar.

The apparatus described, which can be used in developing 8 or more strip chromatograms at one time, depending on their width, has the advantage of cheapness and ease of manipulation.

#### References

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## Book Reviews

*The integrative action of the nervous system.* (6th ed.)  
Sir Charles Sherrington. New Haven: Yale Univ.  
Press, 1948. Pp. xxiv + 433. (Illustrated.) \$6.00.

Much of the life work of a scientist is to be found in the journals of his profession. But occasionally an opportunity arises for the presentation of a general statement—a stimulus for the effort it entails. For Sir Charles Sherrington such an occasion was the invitation to deliver the Silliman lectures at Yale College in 1904. Published first in 1906, *The integrative action of the nervous system*, containing the substance of these lectures, rapidly became an indispensable handbook of neurophysiology. Reviewing the original publication for the *British Medical Journal*, F. W. Mott noted that “the lectures deal with a comparatively new subject, and, to be concise and scientifically accurate, the author has found it necessary to introduce many new terms. . . .” It is significant that most of those new terms remain in current use despite the major changes in technique that inevitably have brought with them new language.

To the physiologist concerned especially with the nervous system, the “Integrative Action” is no substitute for the individual research papers of Sherrington, for these contain the thoughtfully detailed exposition of experimental effort that is one important facet of Sherrington’s many-sided genius. It is rather as a synthesis drawn into a single volume from some 20 years of sustained endeavor that the “Integrative Action” joins the great works of natural philosophy, to claim a wide audience: important reading for anyone who would be informed.

Often reprinted, the book has been for some time unavailable. In 1947 the 17th meeting of the International Physiological Congress was held in Oxford. To commemorate this occasion the “Integrative Action” was republished, initially by the Cambridge University Press, for presentation to the members of the Congress, and subsequently in this country by the Yale University Press. The new edition is entirely reset, the text being retained, but the figures, badly worn by the many reprintings, have been redrawn with commendable accuracy. Legends for figures have been recast, and many page headings are new, the latter sometimes with re-emphasis, possibly born from hindsight. A bibliography of Sir Charles’s publications is a welcome and useful addition.

Entirely unique to the new edition and the most important addition thereto is the foreword written by Sir Charles, in which he responds today to reflection on his writing of 40 years ago and to the work that has been done since, to no small extent by himself. It is here that we find the Sherrington of *Man on his nature*, concerned with the “duality” of energy and mind. The problem has not yet been answered, and who can tell when it will be? Still, if the workings of the mind are mysterious today, at least the mystery of the nervous system in some measure has been dispelled in the hundred years since

Johannes Müller stated that we should never find the means of measuring the speed of nerve conduction. It is characteristic of Sir Charles to be the more concerned with that which is yet to be solved.

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*Vacuum-tube circuits.* Lawrence B. Arguimbau. New York: John Wiley; London: Chapman Hall, 1948. Pp. vii + 668. (Illustrated.) \$6.00.

The need for modern books on vacuum-tube circuits is recognized widely, and much pioneering must be expected before that need is satisfied. It is easier to dream about the requirements of a good book in this field than it is to write one. Prof. Arguimbau has made a most sincere effort to create a book that is both a text for advanced college instruction in engineering and a reference book useful for the self-instruction of trained workers in the field. The first three chapters introduce the subjects of radio communications, diodes and rectifiers, and linear amplifiers, while the fourth stresses the importance of transient response of amplifiers in contrast to their steady state characteristics. Although in some fields of communications, phase shift is of little importance, modern developments demand that detailed attention be directed to its control. Problems of amplitude modulation and detection are attended to in Chapters V and IX, while frequency modulation theory and circuits are discussed in Chapter X. The remaining chapters discuss the subjects of power amplifiers, oscillators, inverse feed-back, pulses and television, and finally, microwaves.

This book has its ups and downs. It contains many sections that are interesting and in which the exposition is clear, while others fall short in these respects. The introductory remarks in the chapter on “Inverse Feed-back” are particularly weak and do not give the reader a clear approach to the understanding of the “cathode-follower” circuit. The fact that the book has such a strong bias in the direction that it is designed for classroom use interferes somewhat with its objective of being useful to advanced workers in this field. One might have thought from the title of the book that it would be a good source of information for the skilled user of electronic and vacuum-tube circuits, who at the same time might not be experienced in working out the details of practical design. For such a reader the present book might prove to be a disappointment. As an aid in classroom use, about 365 problems are distributed through the text.

Commendation is due Prof. Arguimbau, since he has gone far to satisfy his own objectives, even though there remains ample room for additional contributions that might ultimately prove more useful. The book serves well the main purposes for which it was intended and thus constitutes a valuable contribution to the literature.

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